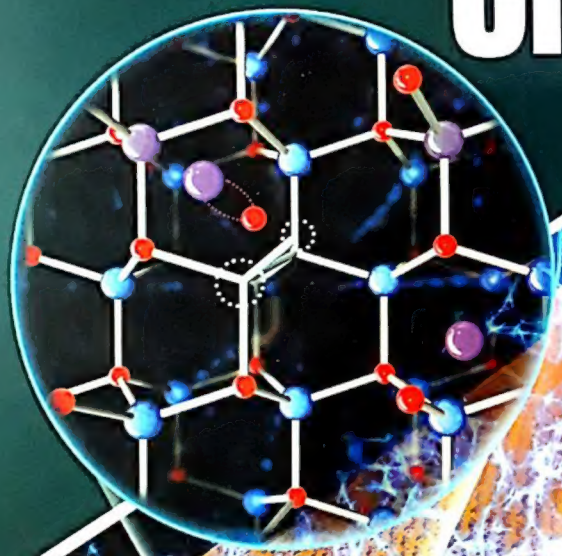
श्री BalaJi

M.S. Chouhan

Advanced Problems in Organic Chemistry

for JEE



11th EDITION

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About the Author

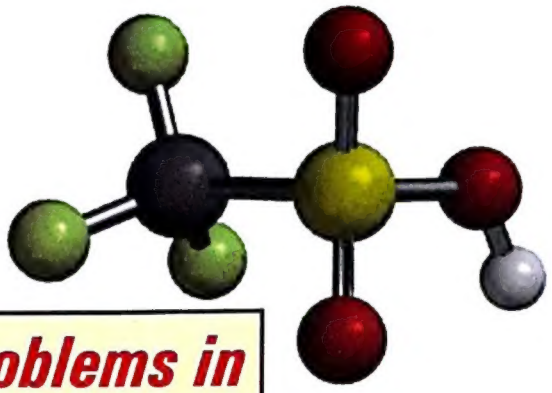
Mahendra Singh Chouhan (MSC Sir) is a renowned name in the realm of Organic Chemistry. Through a Chemical Engineer from Mumbai University, his great passion for the subject led him to impart guidance to IIT-JEE aspirants on a regular basis. His in depth knowledge and vast experience has helped innumerable students to achieve their dream of excelling at IIT, JEE and other such tough challenges.

He has launched a website to extend the benefits of his expertise beyond the geographical barriers to all those who dare to dream and seek - **www.iitjeeorganic.com**.

The website provides expert guidance in all the areas of the subject in a most skillful manner. There are quizzes, challenging questions, notes, e-books and videos etc. This website is a complete guide in itself for organic chemistry and has been designed for IIT-JEE aspirants, keeping in mind the various syllabi and CBSE.

Highly recommended for the high flyers.

श्री BalaJi



Advanced Problems in ORGANIC CHEMISTRY for JEE

by:

M.S. Chouhan

Director

Vibrant Academy, Kota

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A few words to the JEE Aspirants

Dear JEE aspirants,

I hope that this collection of problems will surely help you during your preparation for JEE. In this book, each chapter consists of two levels :

Level 1 - includes the problems having only one option correct. These problems are based on different facts and their twists.

Level 2 - includes unique approach which may be used to solve the problems altogether different from the prevailing trend followed by JEE. These approaches will undoubtedly help you in the quick revision of the key facts and their applications.

I wish all of you a grand success in the ensuing Joint Entrance Examination. Your valuable suggestions and constructive criticism for the betterment of the book are welcome.

M.S. Chouhan

Preface

It is a matter of great pleasure for me to present the eleventh edition of **"Advanced Problems in Organic Chemistry for JEE"** before JEE aspirants. During my teaching experience, I felt that the facts may be made more and more clear to the students through problematic approach. Although an ocean of material in Organic Chemistry is available with the students, yet the approach to design the problems has been changed in recent years and if one tries to swim in this ocean, it will be a very difficult task. To make the students more familiar with trends and tricks how to solve problems, the present problem book has been presented. In the current scenario of stiff competition especially for JEE, one must be clear that almost all the sincere applicants are well equipped with the facts of subject, yet the winner is one who knows how to use these equipments with accuracy and efficiency. As an experienced teacher, I would like to suggest students three golden rules to score high in Organic Chemistry:

1. Don't get behind
2. Work out a number of problems of different types
3. Revise through short notes / learning chart.

I hope that the present book will cater to the needs of JEE aspirants & as a matter of fact, they will enjoy the present venture and I would feel rewarded if this book is found helpful to the students and teachers in real terms. All attempts have been made to make the book error free however a few misprints may inadvertently creep.

I acknowledge the blessing and support of my mother Smt. Raj Kanwar, father Shri B.S. Chouhan, brother Dr. V.S. Chouhan, my wife and daughter. They inspired me all the time during the preparation of this book.

The support and valuable suggestions from my colleagues especially Mr. N. Avasthi , Mr. V. K. jaiswal, Mr. Nitin Jain, Mr. N.K. Sethia, Mr. Vikash Gupta, Mr. Pankaj Joshi, Dr. S. Kothari, Mr. Vineet Khatri, Mr. Ashish Mishra, Mr. Manish Arora, Mr. Govind Khandelwal, Mr. Rahul Pareek, Mr. Rahul Malav, Mr. Divyesh Tiwari, Mr. Omkar Kelapure, Mr. Kishore Kilani, Mr. Mayank Pareek, Mr. Gurpreet Singh, Mr. Yogesh Jain, Madam Anjana Kamal , Mr. Aneet Choudhary, Mr. Shaliwahan Singh Rathore, Mr. Akshay Chaudhary, Mr. Hanuman Sahay, Mrs. Neha Joshi, Mrs. Neetu Jha, Mr. Kamlesh Gupta and Mr. Kumud Ranjan are highly acknowledged. I also pay my sincere thanks to all the esteemed members of **M/s Shri Balaji Publications** in bringing out this book in such a nice form.

In the last, constructive criticism and valuable suggestions from the readers are most welcome to make the book more useful.

M.S. CHOUHAN

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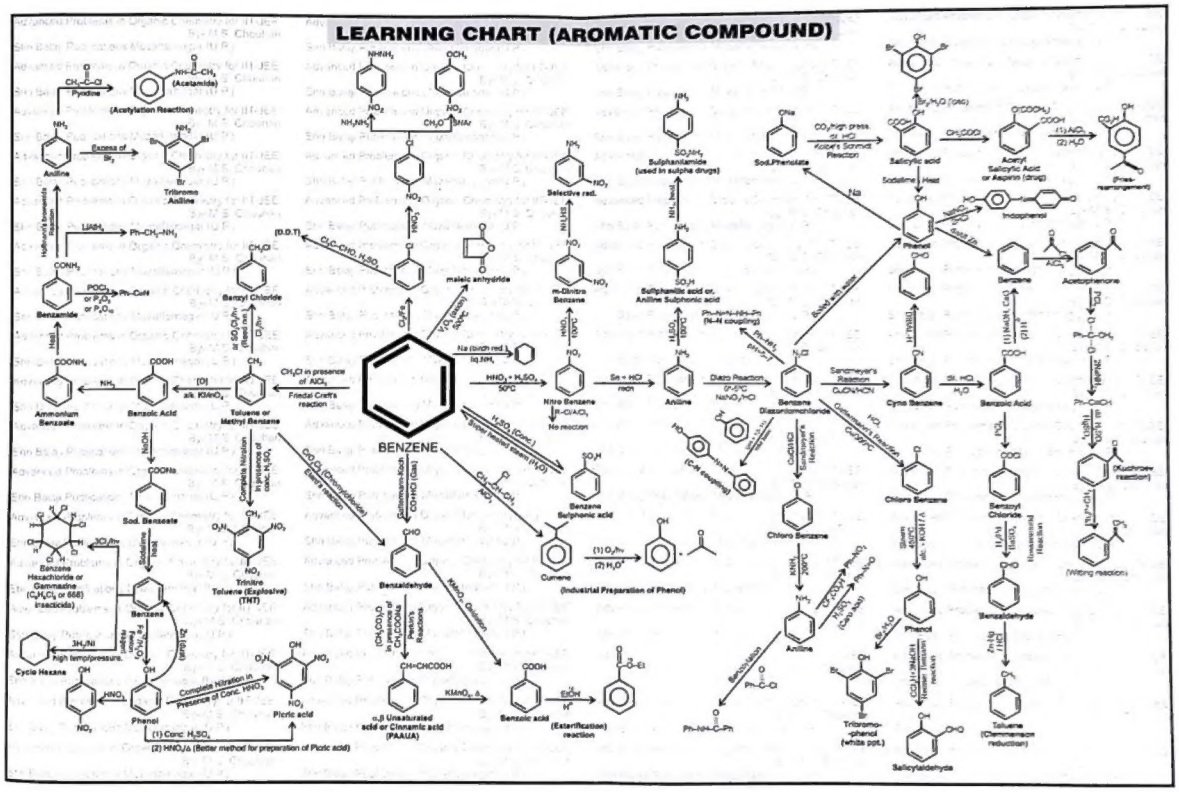
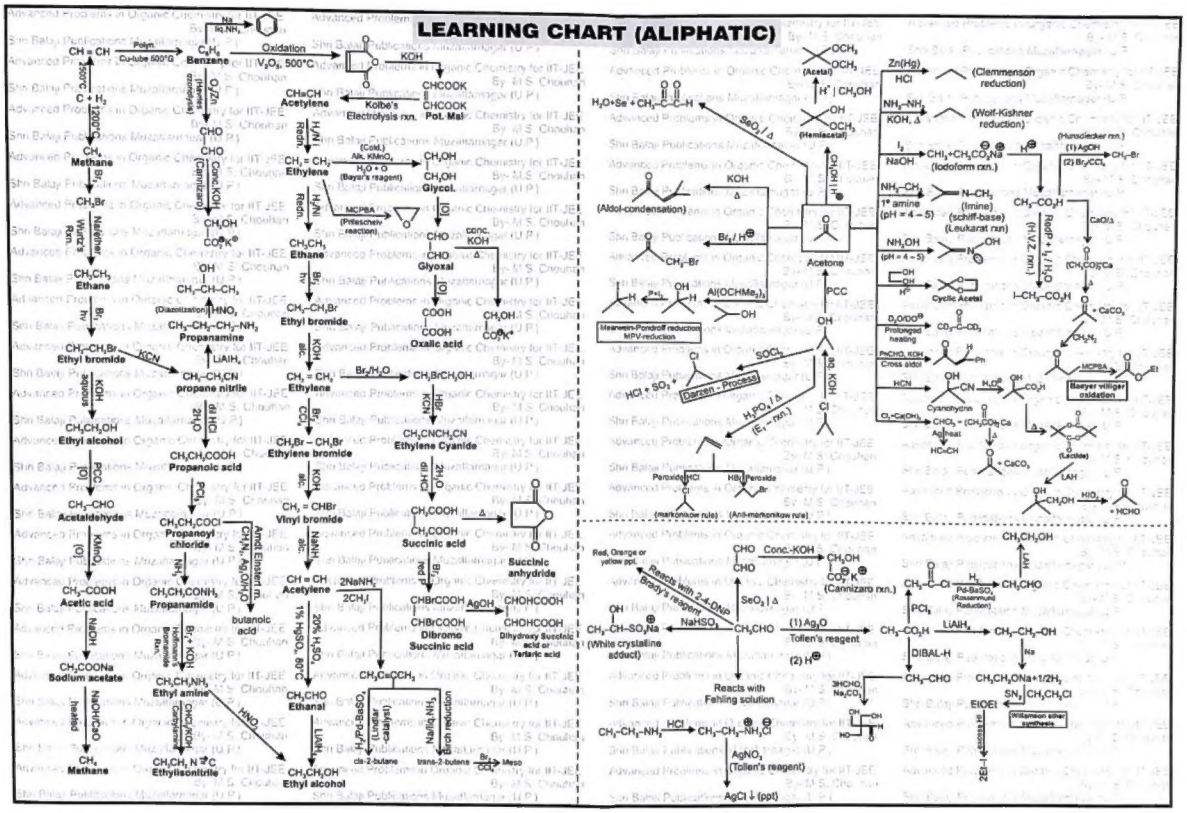
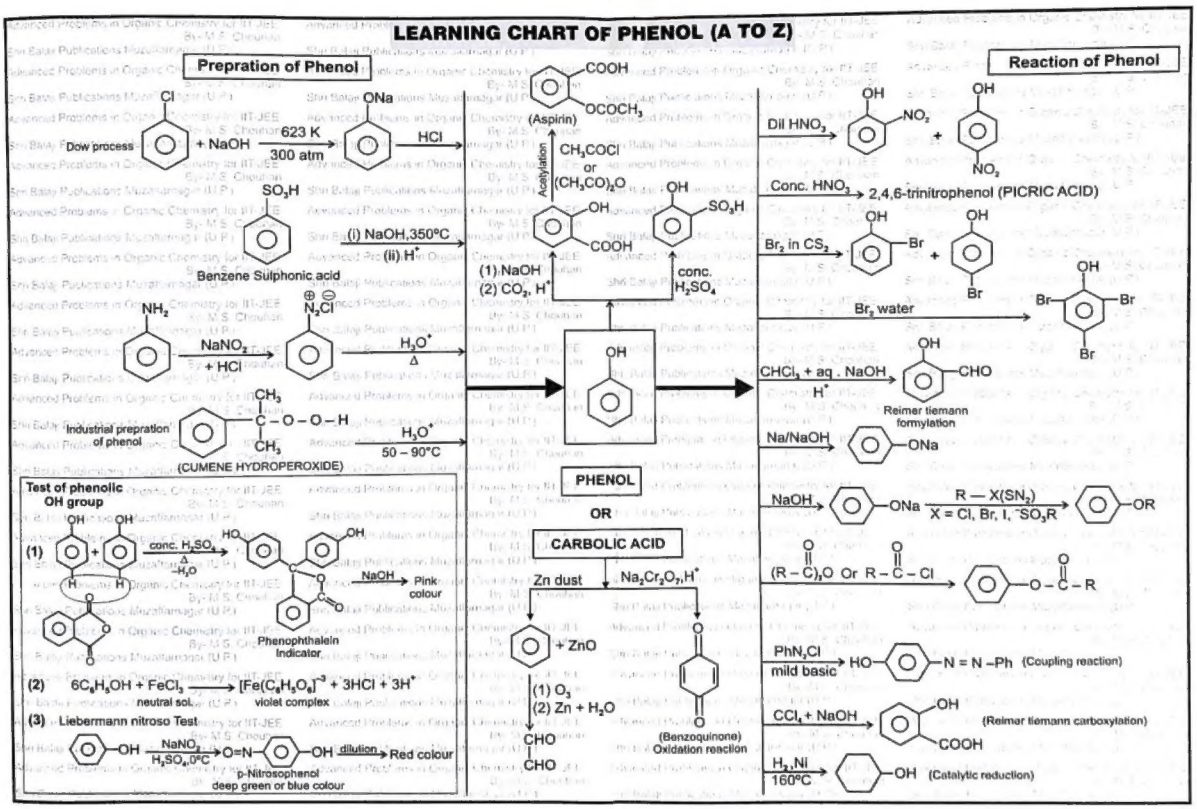

LEARNING CHART (AROMATIC COMPOUND)
BENZENE
Aniline
Acetanilide
Tribromo Aniline
Benzamide
Benzoic Acid
Ammonium Benzoate
Toluene or Methyl Benzene
Benzyl Chloride
Nitro Benzene
m-Dinitro Benzene
Selective red.
Sulphanilic acid or Aniline Sulphonic acid
Sulphanilamide (used in sulpha drugs)
Sod.Phenolate
Salicylic acid
Acetyl Salicylic Acid or Aspirin (drug)
Phenol
Benzene
Acetophenone
Benzaldehyde
Benzoyl Chloride
Benzoic Acid
Cyno Benzene
Benzene Diazonium chloride
Chloro Benzene
Aniline
Phenol
Tribromo-phenol (white ppt.)
Salicylaldehyde
Toluene (Clemmensen reduction)
Benzene Hexachloride or Gammaxine (C6H6Cl6 or 666) insecticide)
Cyclo Hexane
Picric acid
Trinitro Toluene (Explosive) (TNT)
Sod. Benzoate
Benzene Sulphonic acid
Cumene
(Industrial Preparation of Phenol)
Benzaldehyde
Oxidation
Maleic anhydride
α,β Unsaturated acid or Cinnamic acid (PAAUA)
Benzoic acid
(Esterification) reaction
Sandmeyer's Reaction
Gattermann's Reaction
Coupling reaction
Schotten Baumann Reaction
Friedel Craft's reaction
Wurtz Fittig reaction
Fittig reaction
Etard reaction
Rosenmund Reduction
Clemmensen reduction
Wolff-Kishner reduction
Hunsdiecker rxn.
Iodoform rxn.
Schiff-base
Leukarat rxn
Cannizzaro rxn.
Tollen's reagent
Fehling solution
Benedict's reagent
Cross aldol
Cyanohydrin
Darzen - Process
Rosenmund Reduction
Baeyer villiger oxidation
Wittig reaction
Kuchirov reaction
Willamson ether synthesis
Meerwein-Ponndorf reduction
MPV-reduction
Markonikow rule
Anti-markonikow rule

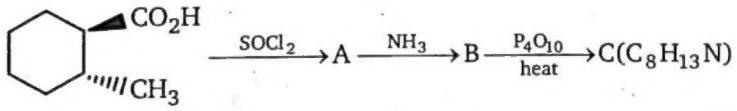

LEARNING CHART (ALIPHATIC)
Methane
Ethane
Ethyl bromide
Ethyl alcohol
Acetaldehyde
Acetic acid
Sodium acetate
Propanoic acid
Propanamide
Ethyl amine
Ethylisonitrile
Propanoyl chloride
Propane nitrile
Propanamine
Benzene
Acetylene
Ethylene
Glycol
Glyoxal
Oxalic acid
Ethylene bromide
Ethylene Cyanide
Vinyl bromide
Succinic acid
Succinic anhydride
Dibromo Succinic acid
Dihydroxy Succinic acid or Tartaric acid
Ethanal
butanoic acid
Acetone
Aldol-condensation
Hemiacetal
Acetal
Cyclic Acetal
Iodoform rxn.
Schiff-base
Leukarat rxn
Cannizzaro rxn.
Tollen's reagent
Fehling solution
Benedict's reagent
Darzen - Process
Rosenmund Reduction
Baeyer villiger oxidation
Meerwein-Ponndorf reduction
MPV-reduction
Markonikow rule
Anti-markonikow rule

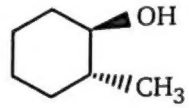

LEARNING CHART OF PHENOL (A TO Z)
Prepration of Phenol
Dow process
+ NaOH
623 K
300 atm
HCl
Benzene Sulphonic acid
(i) NaOH,350°C
(ii) H+
NaNO2 + HCl
H3O+ Δ
Industrial prepration of phenol
(CUMENE HYDROPEROXIDE)
H3O+ 50 – 90°C
Test of phenolic OH group
(1)
conc. H2SO4
Δ -H2O
NaOH
Pink colour
Phenophthalein Indicator
(2) 6C6H5OH + FeCl3 → [Fe(C6H5O6)]-3 + 3HCl + 3H+
neutral sol.
violet complex
(3) Liebermann nitroso Test
NaNO2 H2SO4,0°C
dilution
Red colour
p-Nitrosophenol
deep green or blue colour
(Aspirin)
Acetylation
CH3COCl or (CH3CO)2O
(1) NaOH
(2) CO2, H+
conc. H2SO4
PHENOL
OR
CARBOLIC ACID
Zn dust
Na2Cr2O7,H+
+ ZnO
(1) O3
(2) Zn + H2O
(Benzoquinone)
Oxidation reaction
Reaction of Phenol
Dil HNO3
Conc. HNO3
2,4,6-trinitrophenol (PICRIC ACID)
Br2 in CS2
Br2 water
CHCl3 + aq . NaOH
H+
Reimer tiemann formylation
Na/NaOH
NaOH
R — X(SN2)
X = Cl, Br, I, -SO3R
(R – C)2O Or R – C – Cl
PhN2Cl
mild basic
(Coupling reaction)
CCl4 + NaOH
(Reimer tiemann carboxylation)
H2,Ni 160°C
(Catalytic reduction)

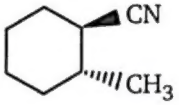
9 CARBOXYLIC ACID AND THEIR DERIVATIVES

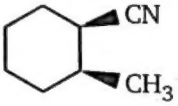
LEVEL-1

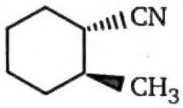
1. Identify C in the following sequence of reactions :



(a) 

(b) 

(c) 

(d) 

2. Saponification (basic hydrolysis) of $C_6H_5C(=O)CH_3$ will yield :

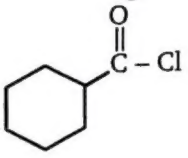
[● = mass – 18 isotope of oxygen]

(a) $C_6H_5-\overset{O}{\overset{\|}{C}}-\bullet^{-}+H\bullet CH_3$

(b) $C_6H_5-\overset{O}{\overset{\|}{C}}-O^{-}+H\bullet CH_3$

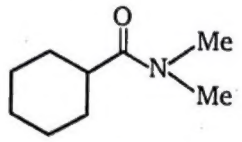
(c) $C_6H_5\overset{O}{\overset{\|}{C}}O^{-}+H\bullet^{-}$

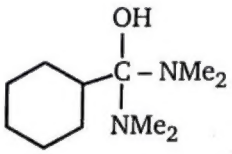
(d) $C_6H_5\overset{O}{\overset{\|}{C}}O^{-}+HOCH_3$

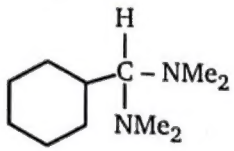
3. 

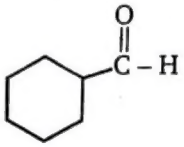
$\xrightarrow[0°C,\,2h]{Me_2NH}$ (X) 86-89% (yield); (3 equivalent)

Product (X) of the reaction is :

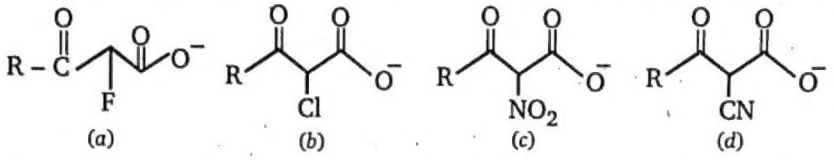
(a) 

(b) 

(c) 

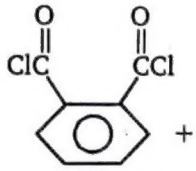
(d) 

4. Which of the following is the correct order of decarboxylation of β-keto carboxylate anion ?



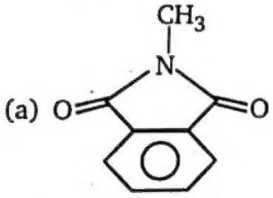
(a) (b) (c) (d)

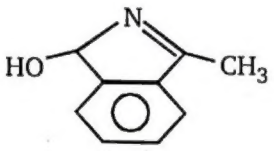
(a) $a > b > c > d$ (b) $c > d > a > b$ (c) $c > d > b > a$ (d) $d > c > a > b$

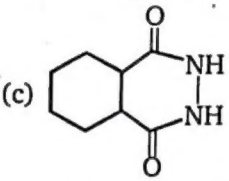
5. 

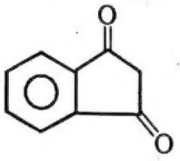
(A)

$+ CH_3 - NH_2 \longrightarrow$ Product of the reaction is :

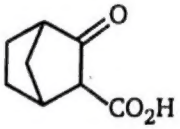
(a) 

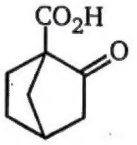
(b) 

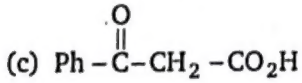
(c) 

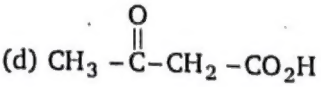
(d) 

6. Which β-keto acid shown will not undergo decarboxylation ?

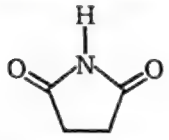
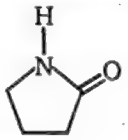
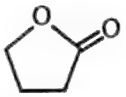
(a) 

(b) 

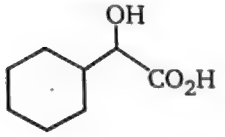
(c) 

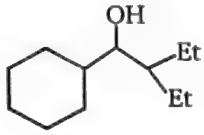
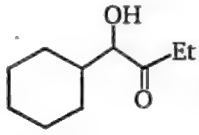
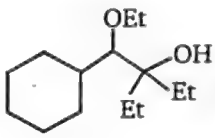
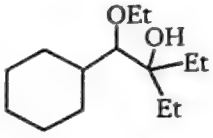
(d) 

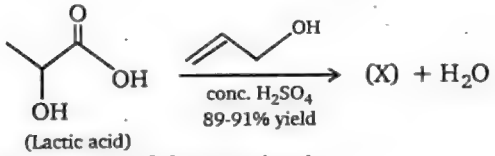
7. Choose the response that matches the correct functional group classification with the following group of structural formulas.

(a) Anhydride	Lactam	Lactone
(b) Lactam	Imide	Lactone
(c) Imide	Lactone	Anhydride
(d) Imide	Lactam	Lactone

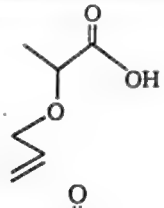
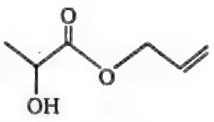
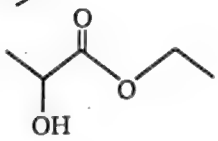
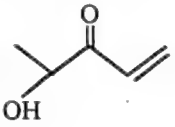
8.  ; Product (*P*) of the reaction is :

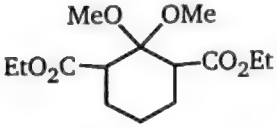
(a) 
(b) 
(c) 
(d) 

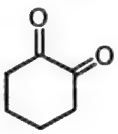
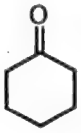
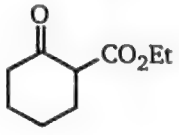
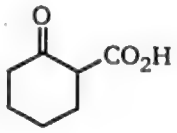
9. 

(Lactic acid)

Product (X) of the reaction is :

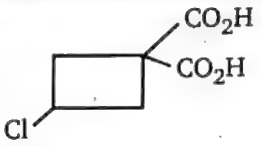
(a) 
(b) 
(c) 
(d) 

10.  , Product (*A*) obtained is :

(a) 
(b) 
(c) 
(d) 

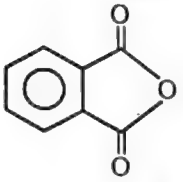
11. Which of the following acid on heating gives geometrical isomers as a product ?

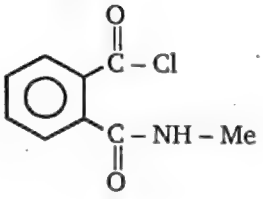
(a) $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CO_2H$

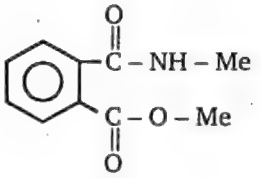
(b) 

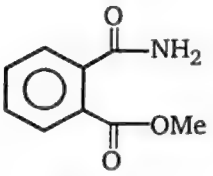
(c) $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-CO_2H$

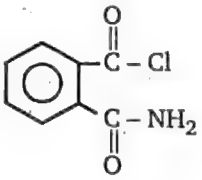
(d) All of these

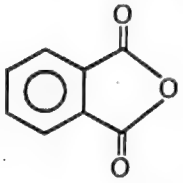
12.  $\xrightarrow{MeOH} A \xrightarrow{PCl_3} B \xrightarrow{MeNH_2} C$; Product (C) of the reaction is :

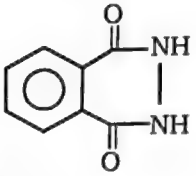
(a) 

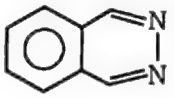
(b) 

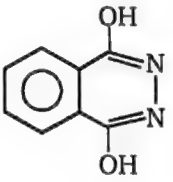
(c) 

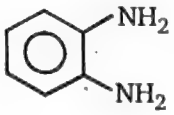
(d) 

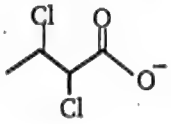
13.  $\xrightarrow{LiAlH_4} A \xrightarrow{PCC} B \xrightarrow{NH_2-NH_2} C$, Product (C) is :

(a) 

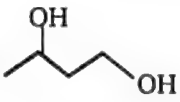
(b) 

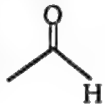
(c) 

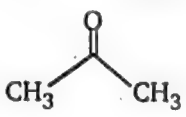
(d) 

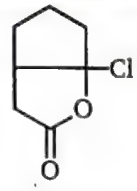
14.  $\xrightarrow{-CO_2} A \xrightarrow{HCl} B \xrightarrow{\text{aq KOH}} C$. Product ($C$) is :

(a) $CH_3-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-H$

(b) 

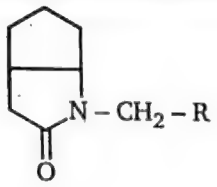
(c) 

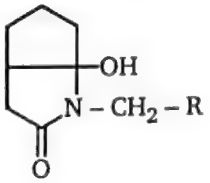
(d) 

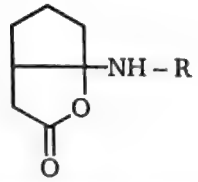
15. 

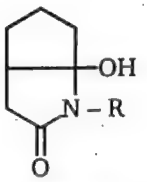
$+R-CH_2-NH_2 \xrightarrow[THF]{K_2CO_3} (A)$ (71%)

In above reaction identify major product (*A*) of the reaction:

(a) 

(b) 

(c) 

(d) 

16. An optically active compound '*X*' has molecular formula $C_4H_8O_3$. It evolves CO_2 with $NaHCO_3$. '*X*' reacts with $LiAlH_4$ to give an achiral compound. '*X*' is :

(a) $CH_3CH_2\underset{\displaystyle OH}{\underset{|}{C}}HCOOH$

(b) $CH_3\underset{\displaystyle Me}{\underset{|}{C}}HCOOH$

(c) $CH_3\underset{\displaystyle CH_2OH}{\underset{|}{C}}HCOOH$

(d) $CH_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_2COOH$

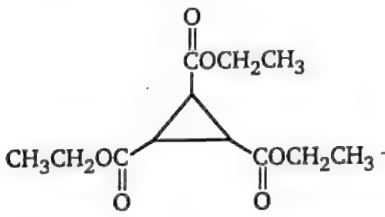
17. $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-O-CH_2-CH_3 + H-\bullet^- \longrightarrow (\bullet = O^{18})$ One of the product of the reaction is :

(a) $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-O-H$

(b) $CH_3-CH_2-\bullet-H$

(c) $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-\bullet^-$

(d) $CH_3-CH_2-\bullet^-$

18. 

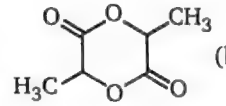
$\xrightarrow{KOH} \xrightarrow{H_3O^+} \xrightarrow{PCl_5} \xrightarrow{LiAlH_4} \xrightarrow{H^+/\Delta} (X)$

Product (X) is :

(a)  (b)  (c)  (d) 

19. Identify final product in the following reaction;

$$CH_3CH(OH)COOH \xrightarrow{\Delta} \text{Product}$$

(a)  (b) $CH_2=CHCO_2H$ (c) $CH_3-\overset{O}{\overset{\|}{C}}CO_2H$ (d) CH_3CH_2OH

20. Select the final product from this sequence of reactions.

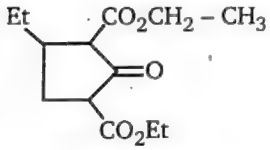
Acetoacetic ester $\xrightarrow{NaOEt}$ $\xrightarrow{CH_3I}$ $\xrightarrow{NaOEt}$ $\xrightarrow{CH_3CH_2CH_2Br}$

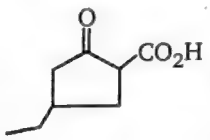
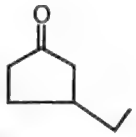
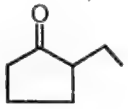
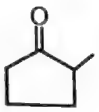
(a) $H_3C-\overset{O}{\overset{\|}{C}}-\overset{CH_3}{\overset{|}{C}}(CH_2CH_2CH_3)-COOC_2H_5$

(b) $H_3C-\overset{CH_3}{\overset{|}{C}}(CH_2CH_2CH_3)-CH_2COOC_2H_5$

(c) $H_3C-\overset{H}{\overset{|}{C}}(CH_2CH_2CH_3)-CH_2COOC_2H_5$

(d) $CH_3CO-\overset{CH_3}{\overset{|}{C}}(CH_3)-CH_2COOC_2H_5$

21.  $\xrightarrow[\text{heat}]{H_2O,\ H_2SO_4}$ (*A*) ; Product (*A*) will be :

(a)  (b)  (c)  (d) 

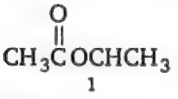
22. $CH_2(CO_2Me)_2 + ? \xrightarrow[\text{(ii) AcOH}]{\text{(i) Na}} CH(CO_2Me)_3$

Which of the following reactants will complete the above reaction ?

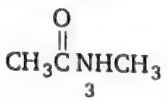
(a) $CH_2(CO_2Me)_2$ (b) $(CO_2Me)_2$

(c) $Cl-CO_2Me$ (d) $COCl_2$

23. Arrange the following in order of increasing reactivity (least ⟶ most) towards nucleophile


1

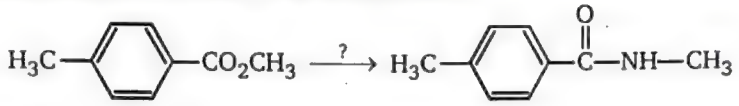

2


3

(a) 1 < 2 < 3 (b) 3 < 1 < 2

(c) 1 < 3 < 2 (d) 2 < 1 < 3

24. Choose the best sequence of reactions for transformation given. Semicolons indicate separate reaction steps to be used in the order shown.



(a) H_3O^+; $SOCl_2$; CH_3NH_2

(b) HO^-/H_2O; PBr_3; Mg; CO_2; H_3O^-; $SOCl_2$; CH_3NH_2

(c) $LiAlH_4$; H_2O; HBr; Mg; CO_2; H_3O^+; $SOCl_2$; CH_3NH_2

(d) None of these would yield the desired product

25. A key step in the hydrolysis of acetamide in aqueous acid proceeds by nucleophilic addition of :

(a) H_3O^+ to $CH_3\overset{O}{\overset{\|}{C}}NH_2$ (b) H_2O to $CH_3\overset{^+OH}{\overset{\|}{C}}NH_2$

(c) H_3O^+ to $CH_3\overset{^+OH}{\overset{\|}{C}}NH_2$ (d) HO^- to $CH_3\overset{^+OH}{\overset{\|}{C}}NH_2$

26. Which reaction is not possible for acetic anhydride ?

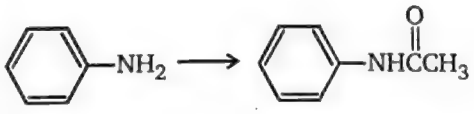
(a) $(CH_3\overset{O}{\overset{\|}{C}})_2O + 2HN(CH_3)_2 \longrightarrow CH_3\overset{O}{\overset{\|}{C}}N(CH_3)_2 + CH_3CO_2^- + H_2\overset{+}{N}(CH_3)_2$

(b) $(CH_3\overset{O}{\overset{\|}{C}})_2O + CH_3CH_2OH \longrightarrow CH_3\overset{O}{\overset{\|}{C}}OCH_2CH_3 + CH_3CO_2H$

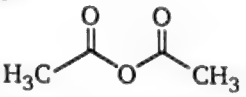
(c) $(CH_3\overset{O}{\overset{\|}{C}})_2O + C_6H_6 \xrightarrow{AlCl_3} CH_3\overset{O}{\overset{\|}{C}}C_6H_5 + CH_3CO_2H$

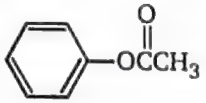
(d) $(CH_3\overset{O}{\overset{\|}{C}})_2O + NaCl \longrightarrow CH_3\overset{O}{\overset{\|}{C}}Cl + CH_3CO_2^-Na^+$

27. All but one of the following compounds react with aniline to give acetanilide. Which one does not?

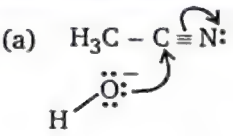


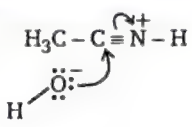
Aniline Acetanilide

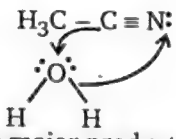
(a) $CH_3\overset{O}{\overset{\|}{C}}—Cl$ (b) 

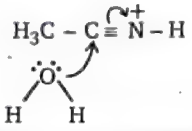
(c) $CH_3\overset{O}{\overset{\|}{C}}—H$ (d) 

28. Which of the following best describes the nucleophilic addition step in the acid-catalyzed hydrolysis of acetonitrile (CH_3CN) ?

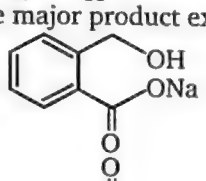
(a) 

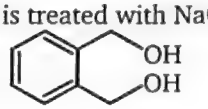
(b) 

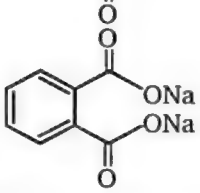
(c) 

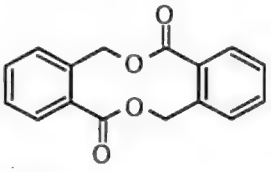
(d) 

29. The major product expected, when Phthalamide is treated with NaOH, is :

(a) 

(b) 

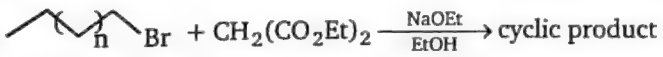
(c) 

(d) 

30. Which of following acid remains unaffected on heating ?

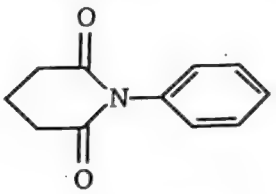
(a) malonic acid (b) maleic acid

(c) Fumaric acid (d) Succinic acid

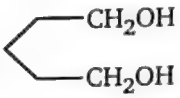
31. 

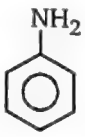
At which value of n the formation of six membered ring takes place ?

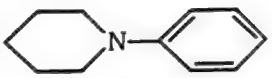
(a) $n = 2$ (b) $n = 3$ (c) $n = 5$ (d) $n = 6$

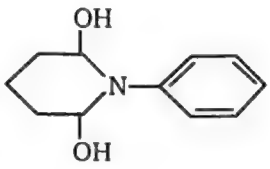
32. 

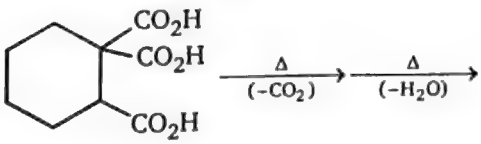
Product of the reaction is :

(a) 

(b) 

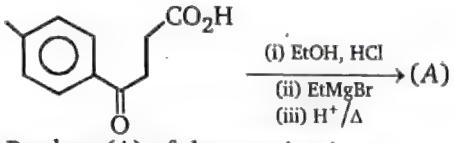
(c) 

(d) 

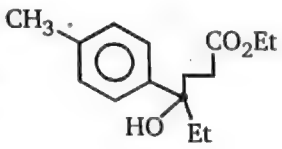
33. 

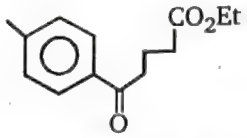
, Product of the reaction is :

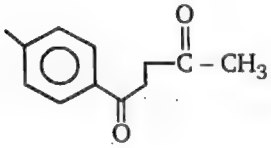
(a) *cis*-anhydride
(b) *trans*--anhydride
(c) both (a) & (b)
(d) mono-basic acid

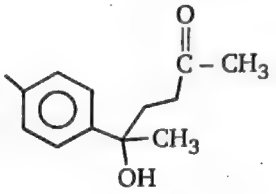
34. 

Product (A) of the reaction is :

(a) 

(b) 

(c) 

(d) 

35. $CH_2-O-COR$
$CH-O-COR_2$ + 3NaOH ⟶ (A) + Salt of fatty acid (soap)
$CH_2-O-COR_3$

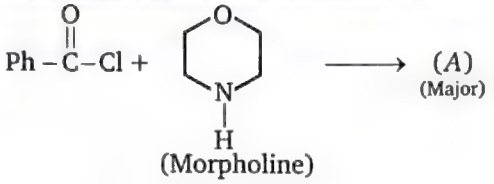
Product (A) of the reaction is :
(a) Ethylene glycol
(b) Glycerol
(c) Glyceryltrinitrate (explosive)
(d) Cumene hydrogen peroxide

36. $CH_3-\underset{\underset{(d)}{Et}}{CH}-OAc \xrightarrow{HO^-}$ Product of the reaction is :
(d=dextro rotatory)

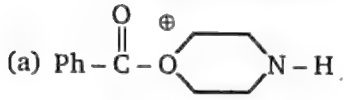
(a) $CH_3-\underset{(d)}{\overset{Et}{\overset{|}{C}}}H-OH$
(b) $CH_3-\underset{Et}{\underset{(l)}{CH}}-OH$
(c) $CH_3-\underset{Et}{\underset{(d)\ \&\ (l)}{CH}}-OH$
(d) $CH_3-\underset{CH_3}{C}=CH_2$

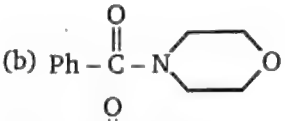
37. $Ph-CH=CH-\overset{O}{\overset{\|}{C}}-O-H \xrightarrow[(ii)\ NH_2]{(i)\ SOCl_2}$ (A) ; Product (A) of the reaction is :

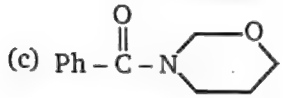
(a) $Ph-CH=CH-\overset{O}{\overset{\|}{C}}-CH_2-NH$ 
(b) $Ph-CH=CH-\overset{O}{\overset{\|}{C}}-NH$ 
(c) $Ph-CH=CH-\overset{O}{\overset{\|}{C}}-H$
(d) $Ph-CH=CH-NH$ 

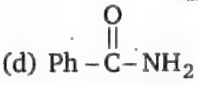
38.  ; Identify the product (*A*).

(Morpholine)

(a) 

(b) 

(c) 

(d) 

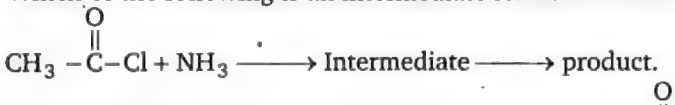
39. 

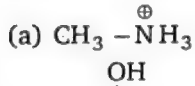
Above reaction is an example of :

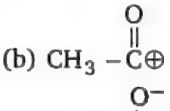
(a) Esterification (b) Saponification

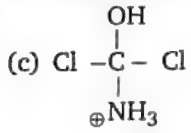
(c) Hydrolysis (d) Trans Esterification

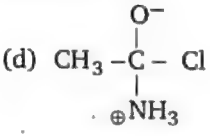
40. Which of the following is an intermediate formed in the reaction shown below ?

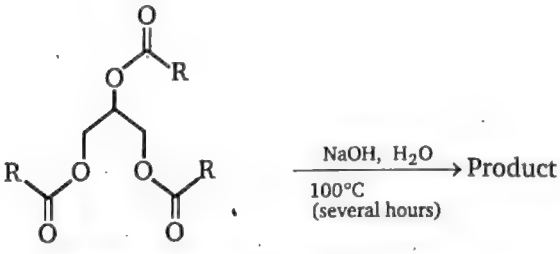


(a) 

(b) 

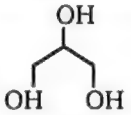
(c) 

(d) 

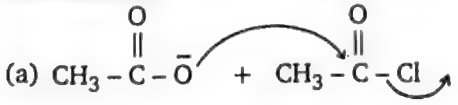
41. 

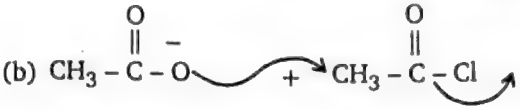
(Principal component of coconut oil.)

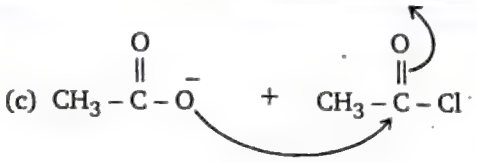
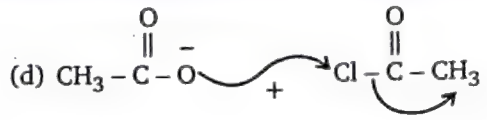
Product is obtained in the above reaction is :

(a) $R-CO_2Na$ (b)  (c) Both (a) and (b) (d) None of these

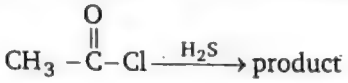
42. The reaction of sodium acetate with acetyl chloride proceeds through which of the following mechanisms ?

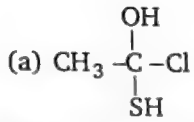
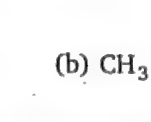
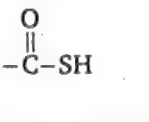
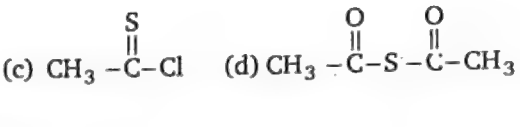
(a) 

(b) 

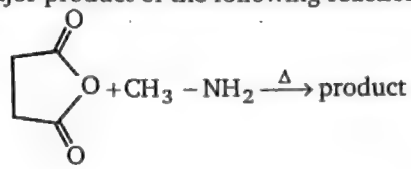
(c)  (d) 

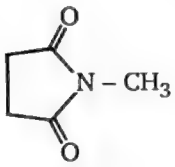
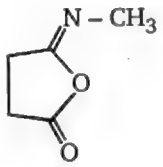
43. Which is the major product of the following reaction ?

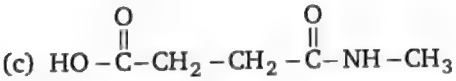


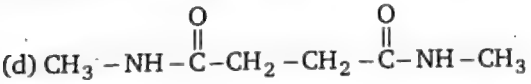
(a)  (b)  (c)  (d) 

44. Which is the major product of the following reaction ?

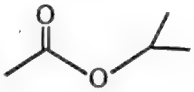
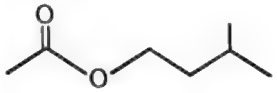


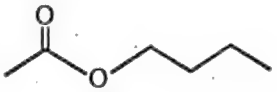
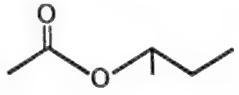
(a)  (b) 

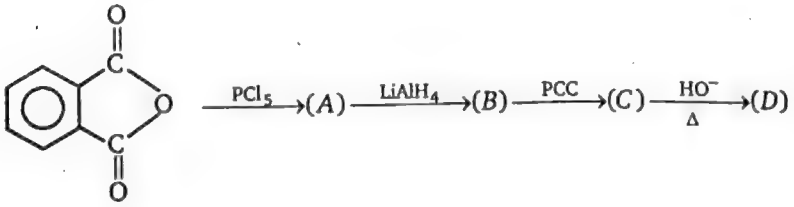
(c) 

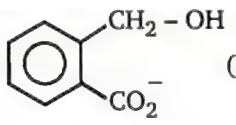
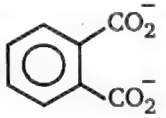
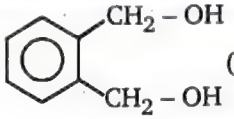
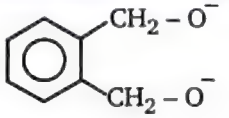
(d) 

45. Ethanoic acid + 3-methyl-1-butanol  (*A*); Compound (*A*) is :

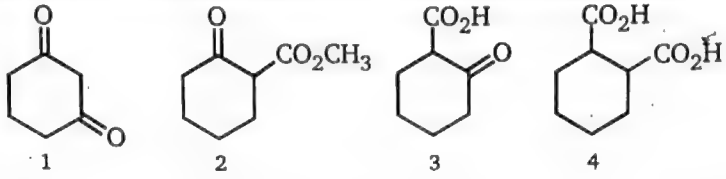
(a)  (b) 

(c)  (d) 

46. 

(a)  (b)  (c)  (d) 

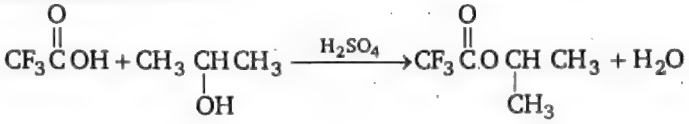
47. Which of the following compounds will undergo decarboxylation on heating ?

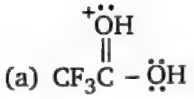
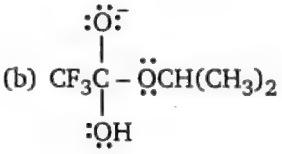


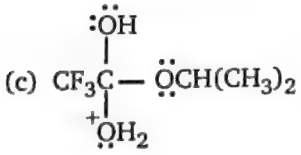
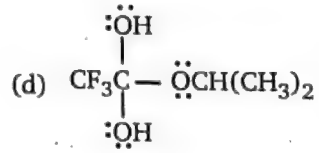
1 2 3 4

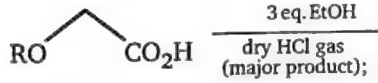
(a) 2 and 3 (b) 3 and 4 (c) 3 only (d) 1 and 4

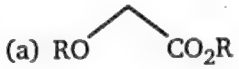
48. Which one of the following is not an intermediate in the generally accepted mechanism for the reaction shown below ?

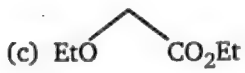
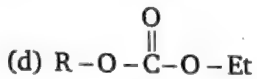


(a)  (b) 

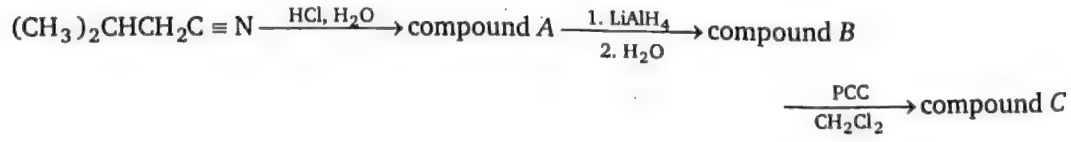
(c)  (d) 

49.  (*A*); Product *A* is :

(a)  (b) 

(c)  (d) 

50. Identify the compound *C* in the following sequence :



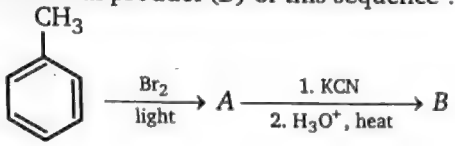
(a) $(CH_3)_2CHC(=O)CH_3$

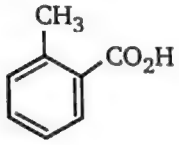
(b) $(CH_3)_2CHCH_2C(=O)OH$

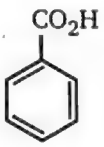
(c) $(CH_3)_2CHCH_2C(=O)H$

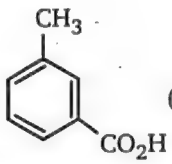
(d) $(CH_3)_2CHCCH_2OH$ (=O)

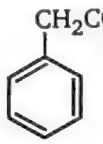
51. What is the final product (*B*) of this sequence ?



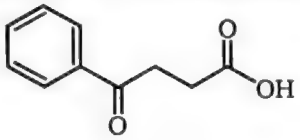
(a) 

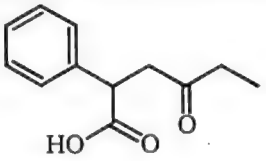
(b) 

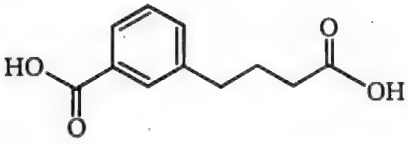
(c) 

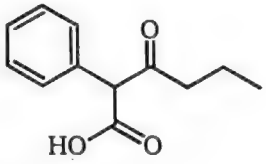
(d) 

52. Which of the following undergoes decarboxylation most readily on being heated ?

(a) 

(b) 

(c) 

(d) 

53. What is compound *Z* ?

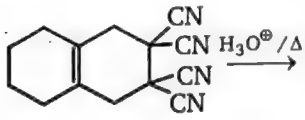
$$CH_3CH_2CH_2Br \xrightarrow{NaCN} X \xrightarrow[heat]{H_3O^+} Y \xrightarrow[H^+]{CH_3CH_2OH} Z$$

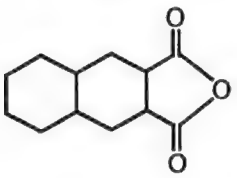
(a) $CH_3CH=CHC(=O)OH$

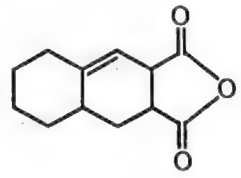
(b) $CH_3CH_2CH_2CH=NOCH_2CH_3$

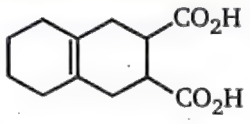
(c) $CH_3CH_2CH_2CH(OCH_2CH_3)_2$

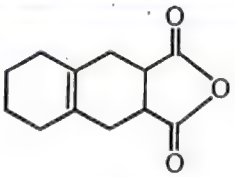
(d) $CH_3CH_2CH_2C(=O)OCH_2CH_3$

54.  $\xrightarrow{H_3O^{\oplus}/\Delta}$ (*A*); Product (*A*) of the reaction is :

(a) 

(b) 

(c) 

(d) 

55. $CH_3-CH=CH-CH_2-CO_2H \xrightarrow{\Delta} (X)$ (major); Product (X) is :

(a) $CH_3-CH=CH-CH_3$

(b) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH_2$

(c) $CH_3-CH_2-CH=CH_2$

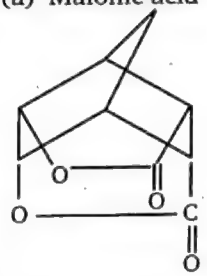
(d) $CH_3-CH=CH_2$

56. $H-O-\overset{\displaystyle O}{\overset{\displaystyle ||}{C}}-(CH_2)_n-\overset{\displaystyle O}{\overset{\displaystyle ||}{C}}-O-H \xrightarrow{\Delta}$ product , At what value of (n) given compound will not evolve CO_2 gas ?

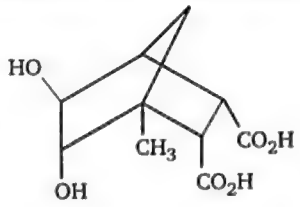
(a) $n = 5$ (b) $n = 4$ (c) $n = 2$ (d) $n = 1$

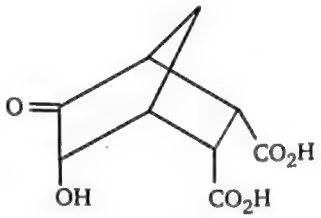
57. $\underset{\displaystyle CO_2H}{\overset{\displaystyle |}{(CH_2)_n}}$; If $(n = 4)$ then di-carboxylic acid would be known as :

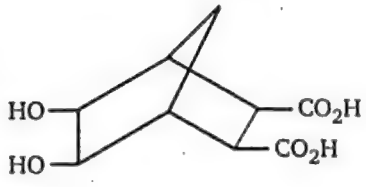
(a) Malonic acid (b) Succinic acid (c) Adipic acid (d) Oxalic acid

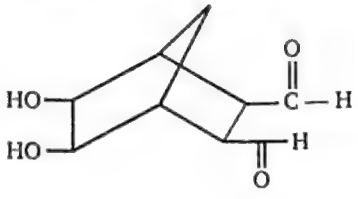
58.  $\xrightarrow{2H_2O}(A)$

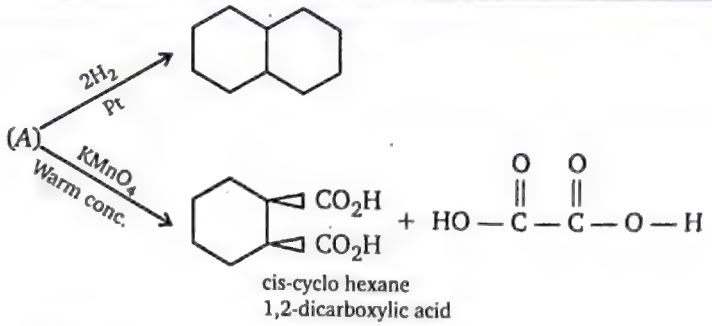
Product (A) of the above reaction is :

(a) 

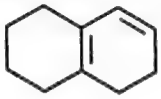
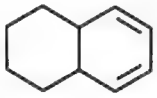
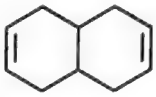
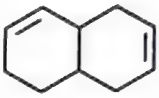
(b) 

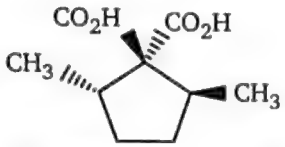
(c) 

(d) 

59. 

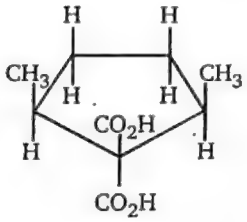
Identify (*A*).

(a)  (b)  (c)  (d) 

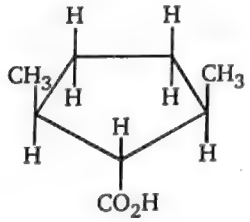
60. 

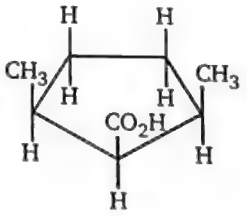
How many product will be formed when above compound undergo de-carboxylation?

(a) 0 (b) 1 (c) 2 (d) 3

61. 

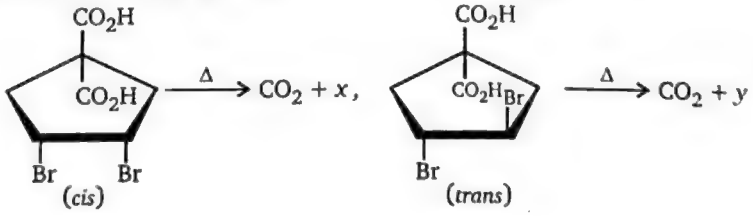
$\xrightarrow[(-CO_2)]{\Delta}$ Product of the reaction is :

(a) 

(b) 

(c) Both (a) and (b) (d) none of these

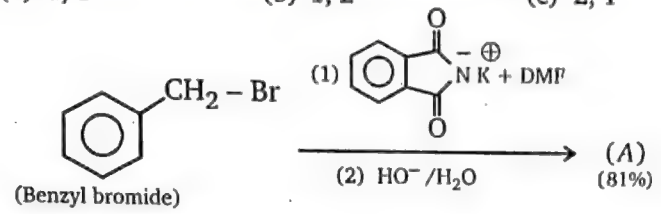
62. Products obtained in the given reactions are shown below.



The number of possible products for x and y are :

(a) 1, 1 (b) 1, 2 (c) 2, 1 (d) 2, 2

63.



(Benzyl bromide)

Product (A) of the above reaction is :

(a) $Ph-NH_2$ (b) $Ph-CH_2-NH_2$

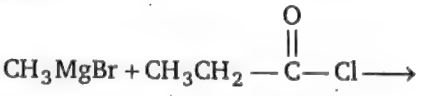
(c) $Ph-CH_2-NH-CO_2H$ (d) $Ph-CH_2-NH-CHO$

64. Which of the following pair is C_2-epimer ?

(a) *D*-Glucose, *D*-Maltose (b) *D*-Glucose, *D*-Mannose

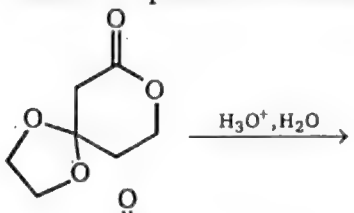
(c) *D*-Allose, *D*-Ribose (d) *D*-Glucose, *D*-Arabinose

65. Total number of enol possible for the compound formed during given reaction will be (including stereoisomer):

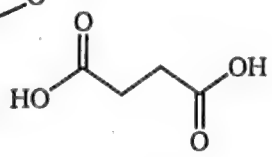


(a) 2 (b) 3 (c) 4 (d) 5

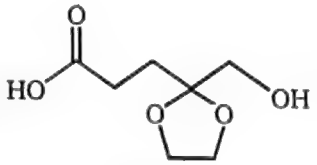
66. What is the product of the following reaction ?



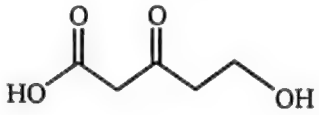
(a)



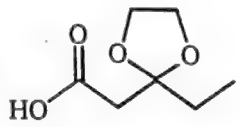
(b)



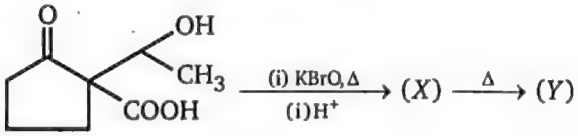
(c)



(d)

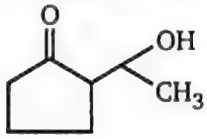


67.

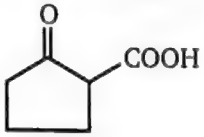


Hence the product (Y) in the above sequence of reactions, is :

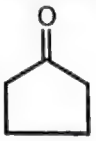
(a)



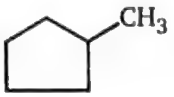
(b)

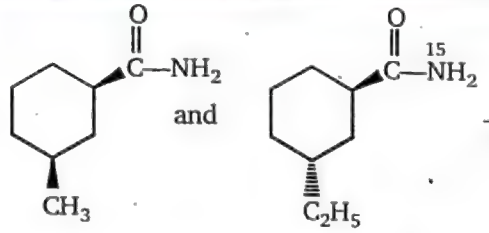


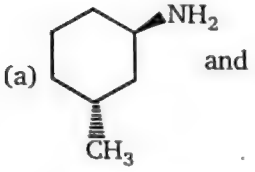
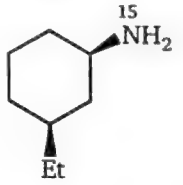
(c)

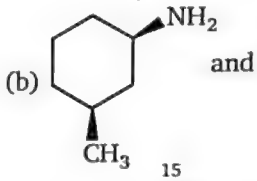
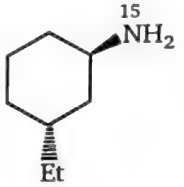


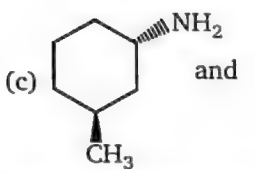
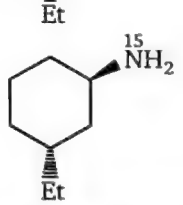
(d)

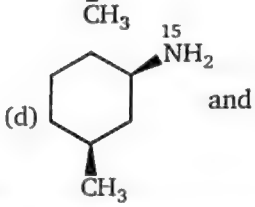
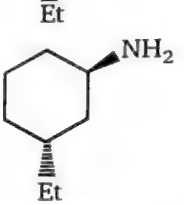


68.  and $\xrightarrow[\text{(Intramolecular migration)}]{\ominus\ OH/Br_2}$ Products are :

(a)  and 

(b)  and 

(c)  and 

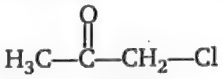
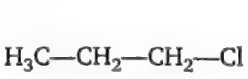
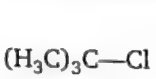
(d)  and 

69. $CH_3CH_2CH(OH)CH(CH_3)_2 + CH_3COCl \xrightarrow{\text{base}} CH_3CH_2CH(OCOCH_3)CH(CH_3)_2 + HCl$

In the above reaction, if the reactant alcohol is a pure R-isomer the product would.

(a) have configuration inverted at the chiral atom
(b) be a racemic mixture
(c) have the same configuration at the chiral atom
(d) be optically inactive

70. The order of S_N1 reactivity in aqueous acetic acid solution for the compounds

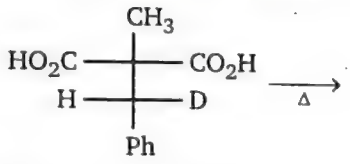
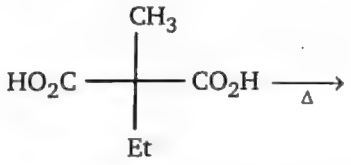
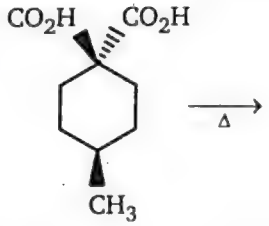
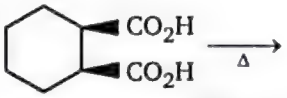
 (1)  (2)  (3)

(a) 1 > 2 > 3 (b) 1 > 3 > 2 (c) 3 > 2 > 1 (d) 3 > 1 > 2

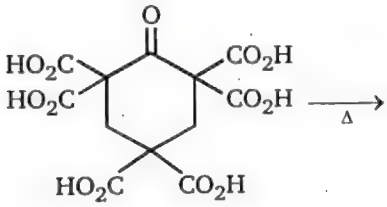
ANSWERS — LEVEL 1															
1.	(b)	**2.**	(b)	**3.**	(a)	**4.**	(c)	**5.**	(a)	**6.**	(b)	**7.**	(d)	**8.**	(b)
9.	(b)	**10.**	(b)	**11.**	(d)	**12.**	(b)	**13.**	(b)	**14.**	(a)	**15.**	(b)	**16.**	(c)
17.	(c)	**18.**	(b)	**19.**	(a)	**20.**	(a)	**21.**	(b)	**22.**	(c)	**23.**	(b)	**24.**	(a)
25.	(b)	**26.**	(d)	**27.**	(c)	**28.**	(d)	**29.**	(c)	**30.**	(c)	**31.**	(b)	**32.**	(c)
33.	(a)	**34.**	(a)	**35.**	(b)	**36.**	(a)	**37.**	(b)	**38.**	(b)	**39.**	(d)	**40.**	(d)
41.	(c)	**42.**	(c)	**43.**	(b)	**44.**	(c)	**45.**	(b)	**46.**	(a)	**47.**	(c)	**48.**	(b)
49.	(b)	**50.**	(c)	**51.**	(d)	**52.**	(d)	**53.**	(d)	**54.**	(d)	**55.**	(c)	**56.**	(c)
57.	(c)	**58.**	(c)	**59.**	(b)	**60.**	(b)	**61.**	(c)	**62.**	(c)	**63.**	(b)	**64.**	(b)
65.	(b)	**66.**	(c)	**67.**	(c)	**68.**	(b)	**69.**	(c)	**70.**	(c)				

LEVEL-2

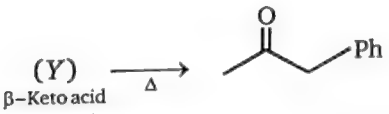
1. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Reaction		Products formed	
(a)		(p)	Diastereomers
(b)		(q)	Racemic mixture
(c)		(r)	Meso compound
(d)		(s)	CO_2 gas will evolve

SUBJECTIVE PROBLEMS

1. 

$\xrightarrow[\Delta]{}$ (X) mole of $CO_2\uparrow$;



(Y) is including stereoisomers. Value of $(X + Y)$ will be

ANSWERS — LEVEL 2

1. a – p, s; b – q, s; c – p, s; d – r

Subjective Problems

1. 8

10 AMINES

LEVEL-1

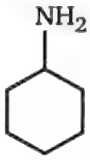
1. In which of the following reaction cyanide will be obtained as a major product ?

(a) $Ph-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow[(ii)\ H_3O^+]{(i)\ LiAlH_4}$

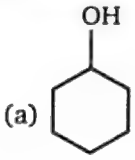
(b) $Ph-\overset{\overset{O}{\|}}{C}-NH_2 \xrightarrow[Br_2]{NaOH}$

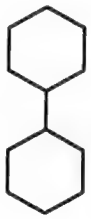
(c) $Ph-\overset{\overset{O}{\|}}{C}-NH_2 \xrightarrow{P_4O_{10}}$

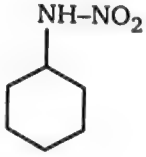
(d) $Ph-\overset{\overset{O}{\|}}{C}-O-H \xrightarrow{SOCl_2} \xrightarrow{NH_3}$

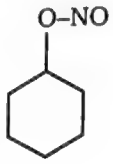
2.  $\xrightarrow{HNO_2}$ *A* (Major) :

Product (*A*) is :

(a) 

(b) 

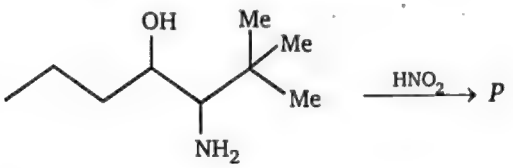
(c) 

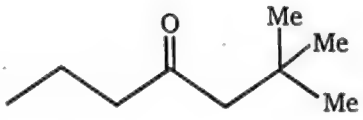
(d) 

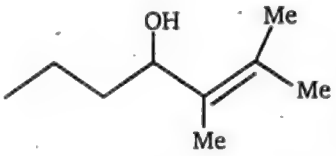
3. Which of the following alkene cannot be prepared by de-amination of *n*-Bu – NH_2 (*n*-Butyl) with $NaNO_2/HCl$?

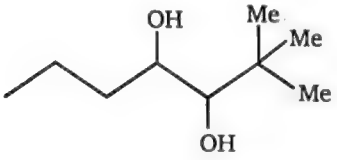
(a) 1-butene (b) *cis*-2-butene (c) *trans*-2-butene (d) Iso-butene

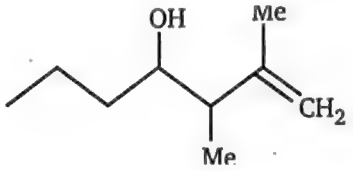
4. Predict the major product *P* in the following reaction.

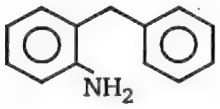


(a) 

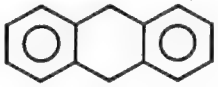
(b) 

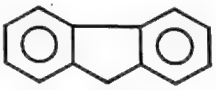
(c) 

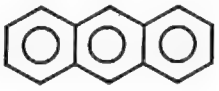
(d) 

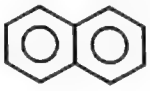
5. 

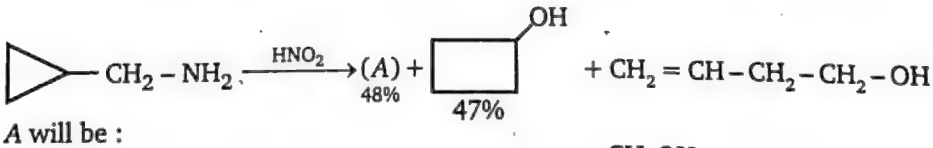
$\xrightarrow[H_2SO_4]{NaNO_2}$ (*A*); Product of this reaction is :

(a) 

(b) 

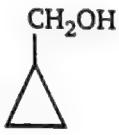
(c) 

(d) 

6. 

A will be :

(a) $CH_2 = CH - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

(b) 

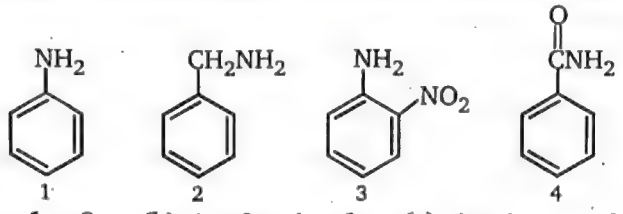
(c) 

(d) 

7. Which of the following isomers of C_8H_9NO is the weakest base ?

(a) *o*-Aminoacetophenone (b) *p*-Aminoacetophenone
(c) *m*-Aminoacetophenone (d) Acetanilide

8. Rank the following compounds in order of increasing basic strength. (weakest → strongest) :



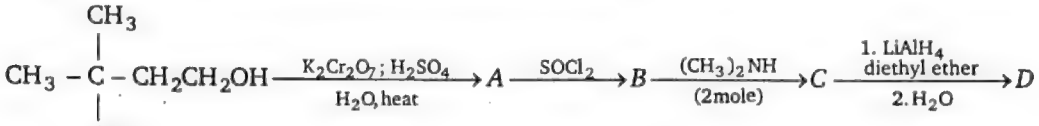
(a) 4 < 2 < 1 < 3 (b) 4 < 3 < 1 < 2 (c) 4 < 1 < 3 < 2 (d) 2 < 1 < 3 < 4

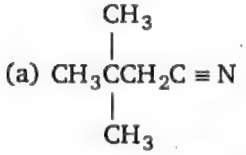
9. Which of the following arylamines will not form a diazonium salt on reaction with sodium nitrite in hydrochloric acid ?

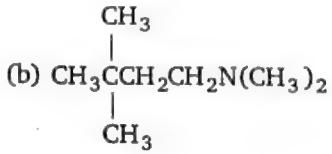
(a) *m*-Ethylaniline (b) *p*-Aminoacetophenone

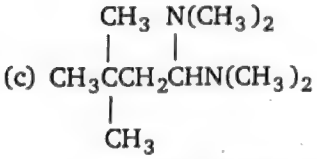
(c) 4-Chloro-2-nitroaniline (d) *N*-Ethyl-2-methylaniline

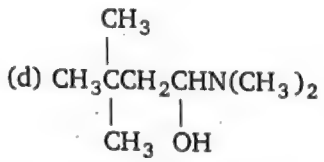
10. Identify product *D* in the following reaction sequence :



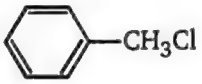
(a) 

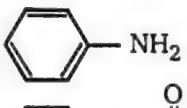
(b) 

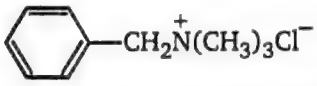
(c) 

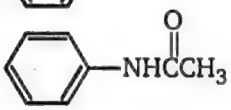
(d) 

11. Which one of the following is best catalyst for the reaction shown below ?

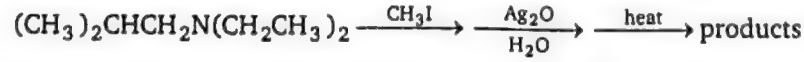
(a) 

(b) 

(c) 

(d) 

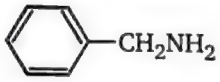
12. The major products obtained from the following sequence of reactions are :

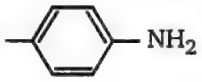


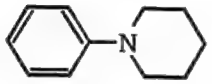
(a) $(CH_3)_2CHCH_2NH_2 + H_2C=CH_2$ (b) $(CH_3)_2NCH_2CH_3 + H_2C=C(CH_3)_2$

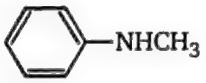
(c)  (d) 

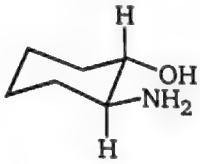
13. Which amine yields *N*-nitroso amine after treatment with nitrous acid ($NaNO_2$, HCl) ?

(a) 

(b) 

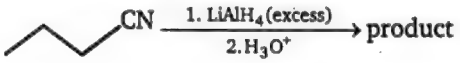
(c) 

(d) 

14.  ; Product (*A*) is :

(a) cyclopentane carboxyaldehyde
(b) cyclohexane-1, 2-diol
(c) 2-aminocyclohexene
(d) cyclohex-2-enol

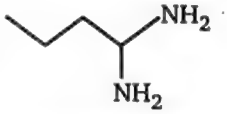
15. Choose the appropriate product for this reaction.



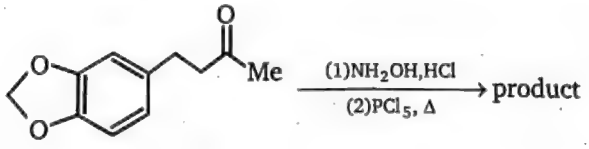
(a) 

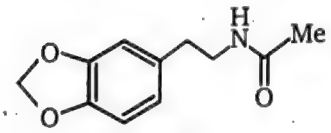
(b) 

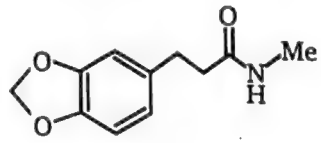
(c) 

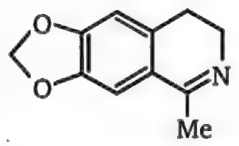
(d) 

16. Which of the following product will be obtained in the given (consider minor product also) Beckmann-type rearrangement ?



(a) 

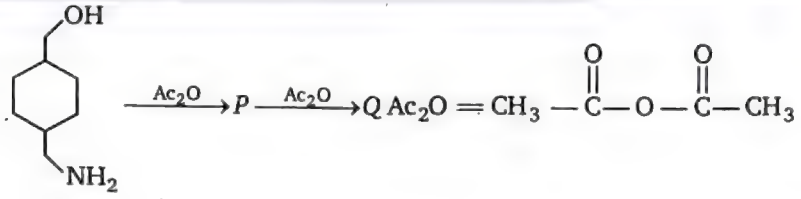
(b) 

(c) 

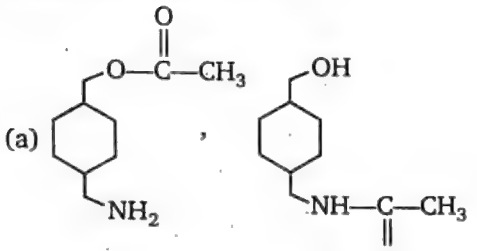
(d) all of these

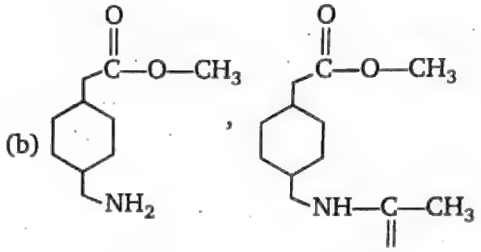
17. Deamination (or) diazotization of *n*-Bu–NH_2 with $NaNO_2$/HCl gives ..... isomeric butene.

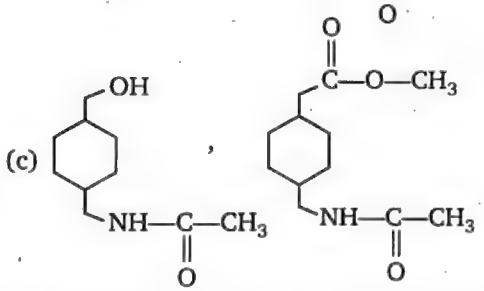
(a) 2 (b) 3 (c) 4 (d) 5

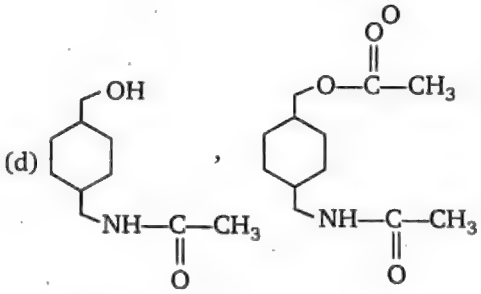
18. 

P and *Q* respectively are :

(a) 

(b) 

(c) 

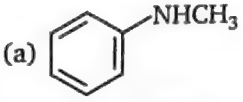
(d) 

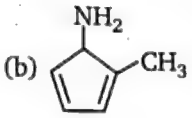
19. A nitrile X is treated with $LiAlH_4$ to obtain compound *Y* (C_2H_7N). In a separate reaction X is hydrolyzed in an acid medium to obtain Z. The product obtained after mixing *Y* and *Z* will be

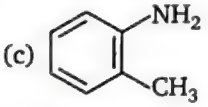
(a) $CH_3CONHCH_2CH_3$ (b) $CH_3CH_2CONHCH_2CH_3$

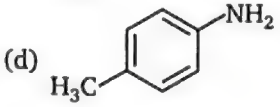
(c) $(CH_3COO^-)(CH_3CH_2NH_3^+)$ (d) $(CH_3CH_2COO^-)(CH_3NH_2^+)$

20. The compound *X*(C_7H_9N) reacts with benzensulfonyl chloride to give *Y*($C_{13}H_{13}NO_2S$) which is insoluble in alkali. The compound *X* is-

(a) 

(b) 

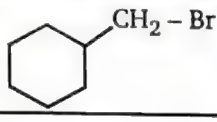
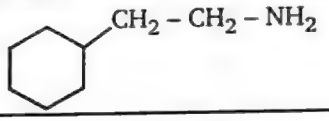
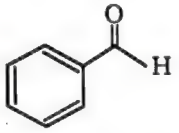
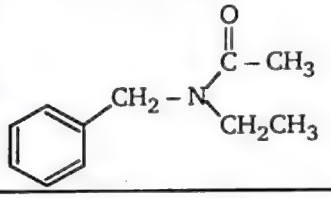
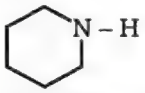
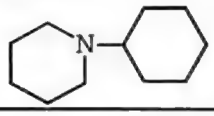
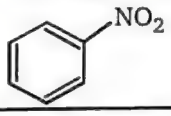
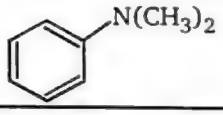
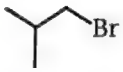
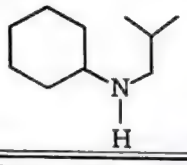
(c) 

(d) 

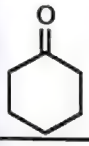
ANSWERS — LEVEL 1															
1.	(c)	**2.**	(a)	**3.**	(d)	**4.**	(a)	**5.**	(b)	**6.**	(b)	**7.**	(d)	**8.**	(b)
9.	(d)	**10.**	(b)	**11.**	(c)	**12.**	(c)	**13.**	(d)	**14.**	(a)	**15.**	(b)	**16.**	(d)
17.	(b)	**18.**	(d)	**19**	(c)	**20.**	(a)								

LEVEL-2

1. Five amine syntheses are outlined below. In each reaction box enter a single letter designating the best reagent and conditions selected from the list at the bottom of the page.

A.		First Step ☐ Second Step ☐	
B.		First Step ☐ Second Step ☐ Third Step ☐	
C.		First Step ☐ Second Step ☐	
D.		First Step ☐ Second Step ☐	
E.		First Step ☐ Second Step ☐ Third Step ☐ Fourth Step ☐	

(a)	(i) $LiAlH_4$ in ether (ii) H_2O & base	
(b)	$C_2H_5NH_2$(cat. $H^{(+)}$)	
(c)	NaCN in alcohol	
(d)	H_2 & Ni catalyst or H_2 & Pd catalyst	
(e)	NaN_3 in alcohol	
(f)	$(CH_3CO)_2O$ & pyridine	
(g)	C_2H_5Br	

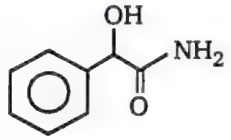
(h)	 , $H^{\oplus}$	
(i)	$2CH_3I$ & pyridine	
(j)	KOH in H_2O	

ANSWERS — LEVEL 2

1. A – c, a or c, d; B – b, d, f; C – h, d; D – d, i or a, i; E – e, a, h, a

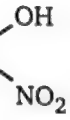
11 CARBENE AND NITRENE

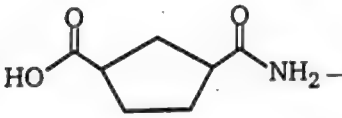
LEVEL-1

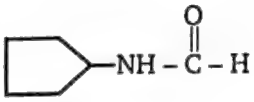
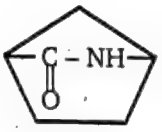
1.  $\xrightarrow{Br_2/KOH}$ product;

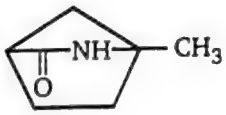
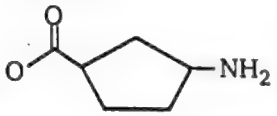
(α-hydroxy amide)

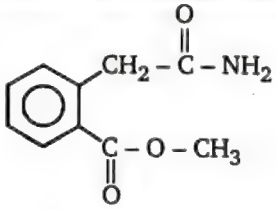
Product of this Hoffmann bromamide reaction is :

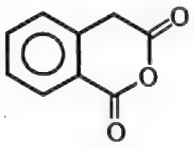
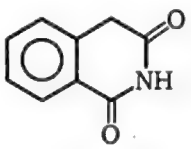
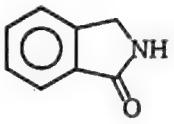
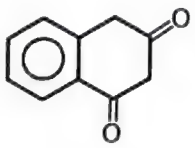
(a) $Ph-\overset{\overset{O}{\|}}{C}-CH_3$ (b) $Ph-CHO$ (c)  (d) $Ph-CH_2-NH_2$

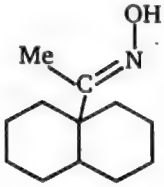
2.  $\xrightarrow{KOBr}$ $(A)\xrightarrow[\Delta]{}(B)$. Compound (B) is :

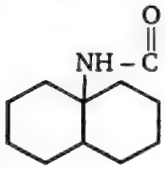
(a)  (b) 

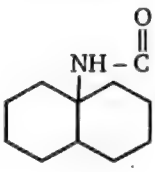
(c)  (d) 

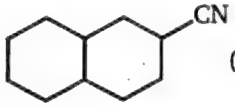
3.  $\xrightarrow{KOBr}$ (*A*); Product (*A*) is :

(a)  (b)  (c)  (d) 

4.  $\xrightarrow{H_2SO_4}$ Product and name of the reaction is :

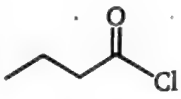
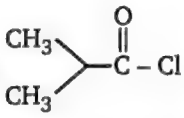
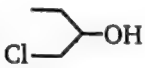
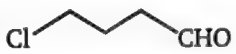
(a)  (Hoffmann bromamide reaction)

(b)  (Beckmann rearrangement)

(c)  (Curtius reaction)

(d) None of these

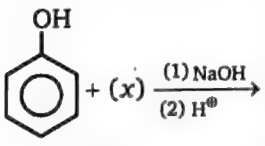
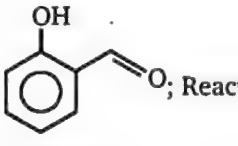
5. $(X)C_4H_7OCl \xrightarrow{NH_3} C_4H_9ON \xrightarrow[KOH]{Br_2} CH_3CH_2CH_2NH_2$; Compound (*X*) is :

(a)  (b)  (c)  (d) 

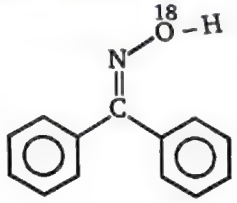
6. Which of the following will not give Hoffmann bromamide reaction ?

(a) $CH_3-\overset{O}{\overset{\|}{C}}-NH_2$ (b) $Ph-\overset{O}{\overset{\|}{C}}-NH_2$

(c) $CH_3-\overset{O}{\overset{\|}{C}}-NH-Br$ (d) $Ph-\overset{O}{\overset{\|}{C}}-NH-Ph$

7.  $\xrightarrow[(2)\ H^{\oplus}]{(1)\ NaOH}$  ; Reactant *x* is :

(a) CH_3Cl (b) CH_2Cl_2 (c) $CHCl_3$ (d) CCl_4

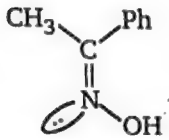
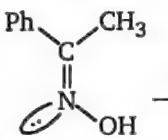
8.  $\xrightarrow[H_2O^{18}]{H_2SO_4}$ (*A*). Product (*A*) of the reaction is :

(a) $Ph-NH-\overset{\overset{O}{\|}}{C}-Ph$

(b) $Ph-NH-\overset{\overset{O^{18}}{\|}}{C}-Ph$

(c) $(Ph)_2-\overset{\overset{OH}{|}}{C}-NH_2$

(d) $Ph-CH_2-NH-Ph$

9.  $\xrightarrow{H_2SO_4}$ (*A*),  $\xrightarrow{H_2SO_4}$ (*B*)

Product (*A*) & (*B*) respectively in the above reaction are :

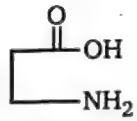
(a) $Ph-\overset{\overset{O}{\|}}{C}-NH-CH_3$, $Ph-\overset{\overset{O}{\|}}{C}-NH-CH_3$

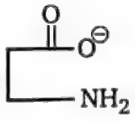
(b) $CH_3-\overset{\overset{O}{\|}}{C}-NH-Ph$, $CH_3-\overset{\overset{O}{\|}}{C}-NH-Ph$

(c) $Ph-\overset{\overset{O}{\|}}{C}-NH-CH_3$, $CH_3-\overset{\overset{O}{\|}}{C}-NH-Ph$

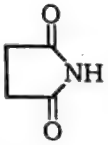
(d) $CH_3-\overset{\overset{O}{\|}}{C}-NH-Ph$, $Ph-\overset{\overset{O}{\|}}{C}-NH-CH_3$

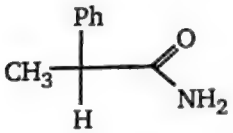
10. NBS $\xrightarrow{KOBr}$ (*A*) . Product (*A*) is :

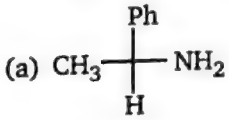
(a) 

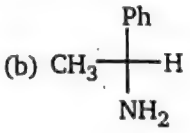
(b) 

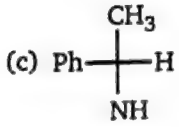
(c) 

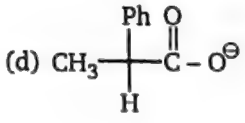
(d) 

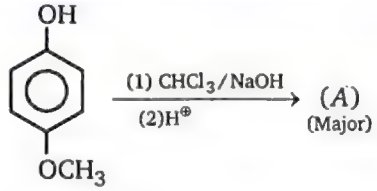
11.  $\xrightarrow{NaOBr}$ (*A*) ; Product of the reaction is :
(major)

(a) 

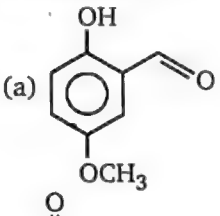
(b) 

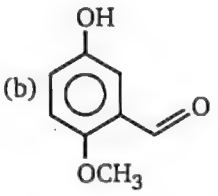
(c) 

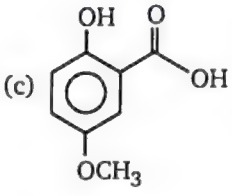
(d) 

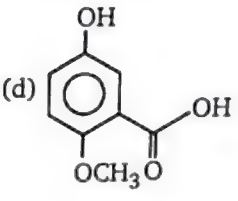
12. 

Product (*A*) is :

(a) 

(b) 

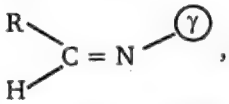
(c) 

(d) 

13. $R-\overset{\overset{O}{\|}}{C}-NH_2 + x NaOH + Br_2 \longrightarrow R-NH_2 + 2NaBr + Na_2CO_3 + H_2O$

Number of moles of NaOH used in above Hoffmann bromamide reaction is :

(a) 3 (b) 4 (c) 5 (d) 6

14. 

, Rate of reaction toward Beckmann rearrangement

when $\gamma = \underset{(i)}{CH_3CO_2^-}$, $\underset{(ii)}{Cl-CH_2-CO_2^-}$, $\underset{(iii)}{Ph-SO_3^-}$

(a) (i) > (ii) > (iii) (b) (ii) > (i) > (iii)

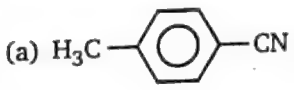
(c) (iii) > (ii) > (i) (d) (iii) > (i) > (ii)

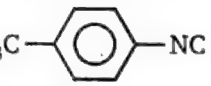
15. When primary amine reacts with chloroform in ethanolic KOH, then product is :

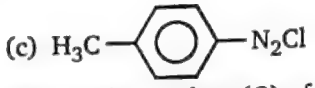
(a) an isocyanide (b) an aldehyde

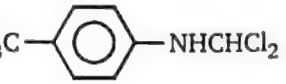
(c) a cyanide (d) an alcohol

16. The reaction of chloroform with alcoholic KOH and *p*-toluidine forms :

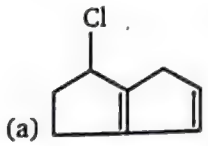
(a) 

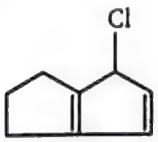
(b) 

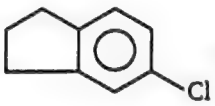
(c) 

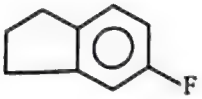
(d) 

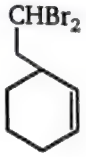
17. What is the product (*Q*) of the following reaction ?

(a) 

(b) 

(c) 

(d) 

18.  $\xrightarrow[\Delta]{NaOH,\ 50\%}$ (*A*) ; Product (*A*) is :

(a) 

(b) 

(c) 

(d) 

19. Which of the following reaction, does not give chloro benzene as a product ?

(a)  $\xrightarrow{CHCl_3,\ HO^-}$

(b)  $\xrightarrow{CHBrCl_2,\ HO^-}$

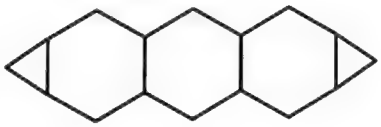
(c)  $\xrightarrow{CHBr_2Cl,\ HO^-}$

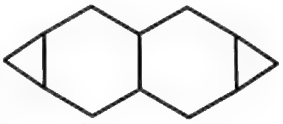
(d)  $\xrightarrow{CHFClBr,\ HO^-}$

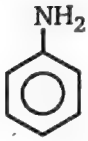
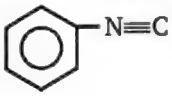
20.  $\xrightarrow[Zn/Cu]{(3\,mole)\,CH_2I_2}$ (*A*) ; Compound (*A*) is :

(a) 

(b) 

(c) 

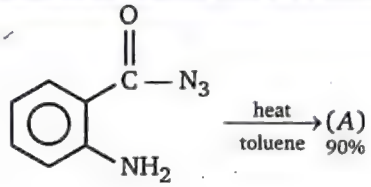
(d) 

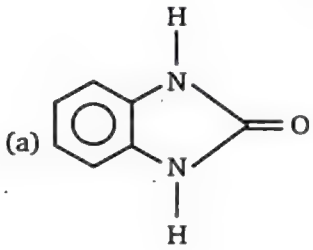
21.  $+ CHCl_3 + xKOH \longrightarrow$ 

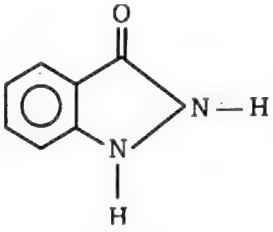
x = moles of KOH consumed is :

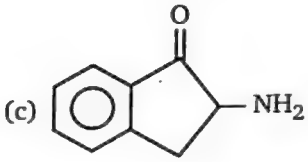
(a) 1 (b) 2 (c) 3 (d) 4

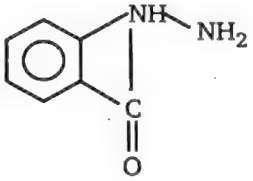
22. Heating the acyl azide in dry toluene under reflux for 3-hours give a 90% yield for a heterocyclic product. Identify the product (*A*).

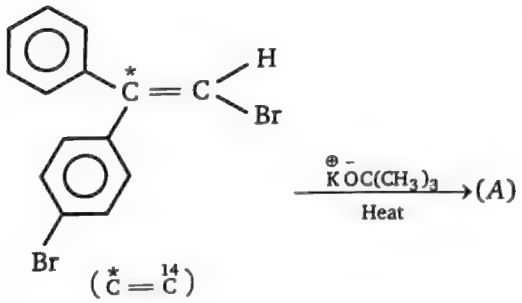


(a) 

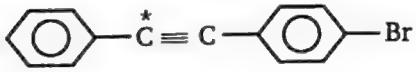
(b) 

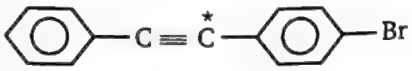
(c) 

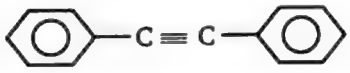
(d) 

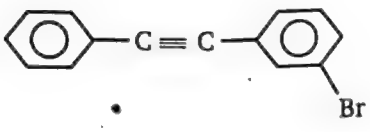
23. 

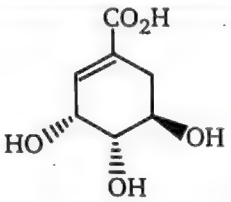
$(\overset{*}{C}=\overset{14}{C})$

(a) 

(b) 

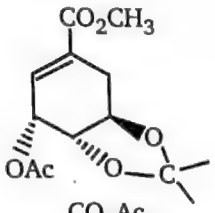
(c) 

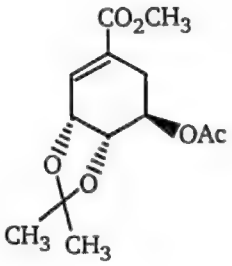
(d) 

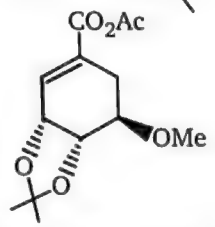
24. 

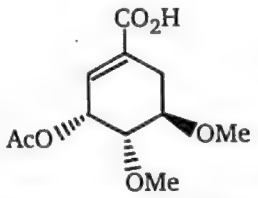
$\xrightarrow[\text{(2) acetone/H}^+\text{ (3)Ac}_2\text{O, Acetic anhydride}]{\text{(1) CH}_2\text{N}_2}$ (*A*) (de-colourises Br_2 water)

Product (*A*) of the above reaction is :

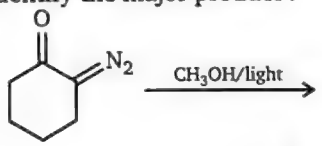
(a) 

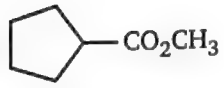
(b) 

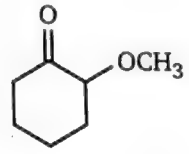
(c) 

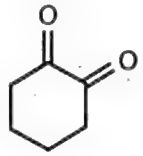
(d) 

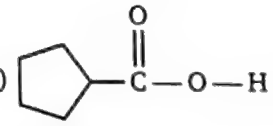
25. A rather interesting example of the Wolff rearrangement with 2-diazocyclohexanone in methanol is given below. Identify the major product :



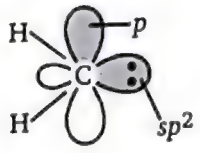
(a) 

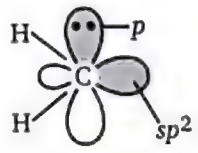
(b) 

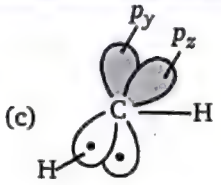
(c) 

(d) 

26. The orbital picture of a singlet carbene ($:CH_2$) can be drawn as :

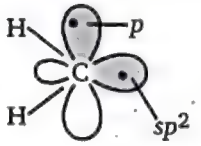
(a) 

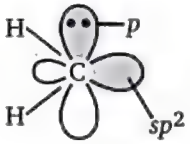
(b) 

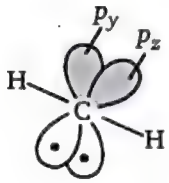
(c) 

(d) none of these

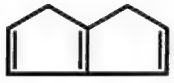
27. The orbital picture of a triplet carbene can be drawn as :

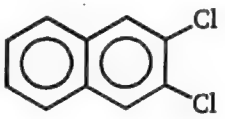
(a) 

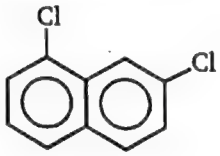
(b) 

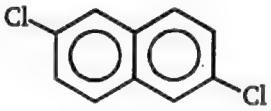
(c) 

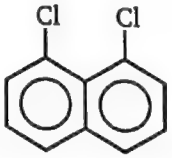
(d) none of these

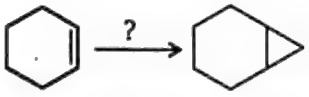
28.  $\xrightarrow[KOH]{CHCl_3}(A)\xrightarrow[KOH]{CHCl_3}(B)$; Product (B) is :

(a) 

(b) 

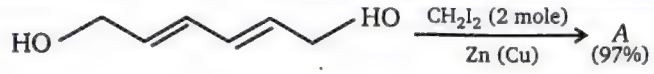
(c) 

(d) 

29. 

Select the suitable reagent for above conversion.

(a) CH_2N_2 / Δ
(b) CBr_4 / RLi
(c) $H_2C=CH_2$
(d) t-BuOK

30. 

Product (*A*) will be :

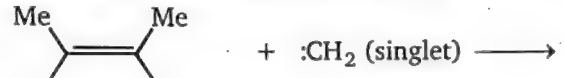
(a) 

(b) 

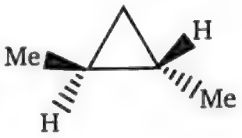
(c) 

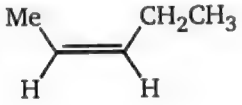
(d) 

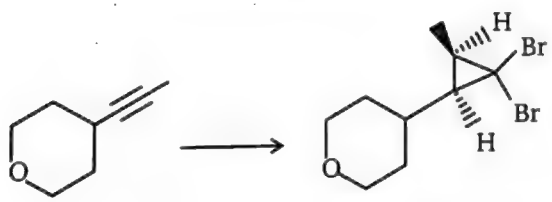
31. The major product formed in the following reaction is



(a) 

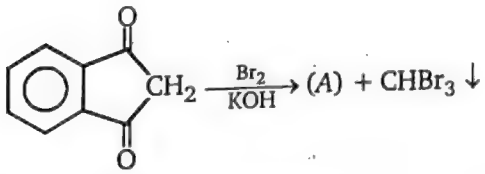
(b) 

(c) 50 : 50 mixture of above two compounds (d) 

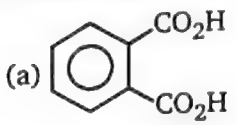
32. 

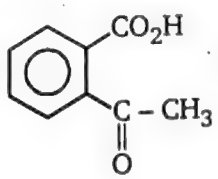
To carry out above conversion reagent used in decreasing order.

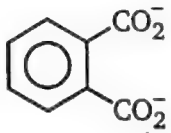
(a) Na/liq. NH_3 , $CHBr_3$/NaOH(Δ)
(b) H_2/Pd - $CaCO_3$, $CHBr_3$/NaOH(Δ)
(c) Na/liq. NH_3 , $CHCl_3$/NaOH
(d) H_2/Pd - $CaCO_3$, $CHCl_3$/NaOH

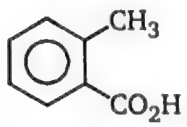
33. 

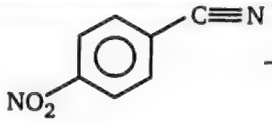
Product (*A*) of the reaction is :

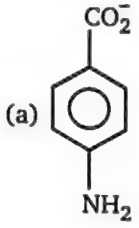
(a) 

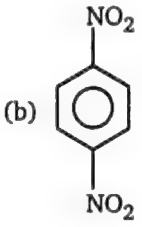
(b) 

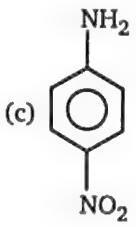
(c) 

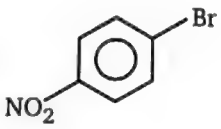
(d) 

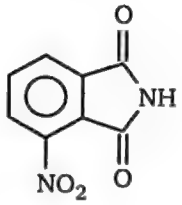
34.  $\xrightarrow[(2)\ HO^-, Br_2]{(1)\ HO^-(1\ mole)}$ (*A*); Product (*A*) is :

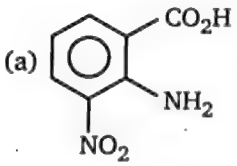
(a) 

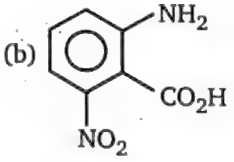
(b) 

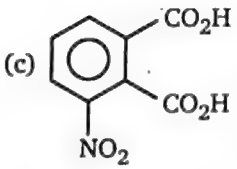
(c) 

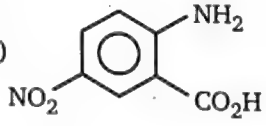
(d) 

35.  $\xrightarrow[H_2O]{NaOCl}$ (*X*) ; Product *X* will be :

(a) 

(b) 

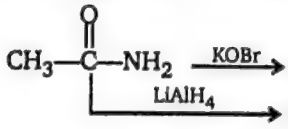
(c) 

(d) 

36. $CH_3-CH_2-CH_2-CH_2-CH_3 \xrightarrow{CH_2N_2/\Delta}$ Products

Which of the following product(s) is/are can be obtained in the above reaction.

(a) Isopentane (b) 3-Methyl hexane (c) *n*-Pentane (d) 3-Methyl pentane

37.  (*A*) Relation between (*A*) & (*B*) is :

(a) Identical (b) Functional isomer (c) Homologous (d) Positional isomers

38. If we use pyrene (CCl_4) in the Riemer-Tiemann reaction in place of chloroform, the product formed is :

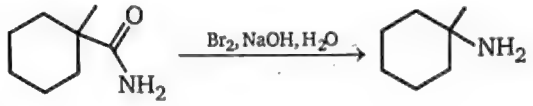
(a) Salicylaldehyde (b) Phenolphthalein (c) Salicylic acid (d) Cyclohexanol

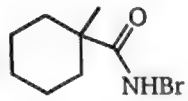
39. When ethyl amine is heated with chloroform and alcoholic KOH, a compound with offensive smell is obtained. This compound is :

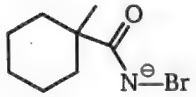
(a) A secondary amine (b) An isocyanide

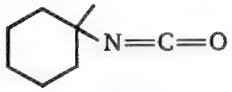
(c) A cyanide (d) An acid

40. Which of the following species would not be involved in the Hoffmann rearrangement shown below ?



(a) 

(b) 

(c) 

(d) All of the above are involved in the reaction.

41. In which of the following reactions migration of alkyl group from carbon to oxygen is observed ?

(a) Pinacol-pinacolone rearrangement

(b) Bayer-villiger oxidation.

(c) Prepration of phenol from cumene hydroperoxide.

(d) Both (b) & (c)

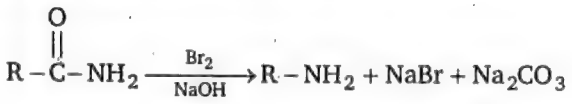
ANSWERS — LEVEL 1

1.	(b)	**2.**	(b)	**3.**	(c)	**4.**	(b)	**5.**	(a)	**6.**	(d)	**7.**	(c)	**8.**	(b)
9.	(c)	**10.**	(b)	**11.**	(a)	**12.**	(a)	**13.**	(b)	**14.**	(c)	**15.**	(a)	**16.**	(b)
17.	(d)	**18.**	(a)	**19.**	(d)	**20.**	(a)	**21.**	(c)	**22.**	(a)	**23.**	(b)	**24.**	(b)
25.	(a)	**26.**	(a)	**27.**	(c)	**28.**	(c)	**29.**	(a)	**30.**	(b)	**31.**	(a)	**32.**	(b)
33.	(c)	**34.**	(c)	**35.**	(b)	**36.**	(d)	**37.**	(c)	**38.**	(c)	**39.**	(b)	**40.**	(d)
41.	(d)														

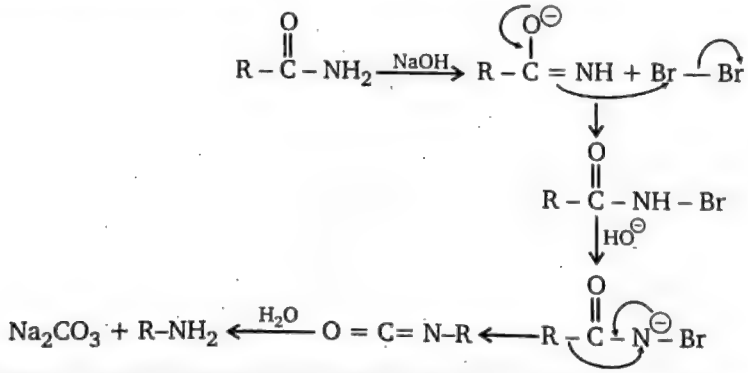
LEVEL-2

1. Comprehension

Hoffmann bromamide reaction involves conversion of a carboxylic acid amide into an amine with a loss of a carbon atom on treatment with aqueous sodium hypobromite. Thus Hoffmann result in shortening of a carbon chain.

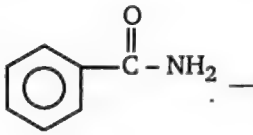


Mechanism of the reaction is :



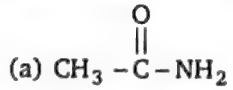
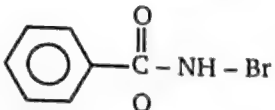
A. Number of moles of NaOH consumed in above reaction.

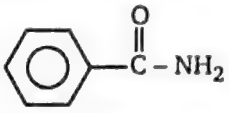
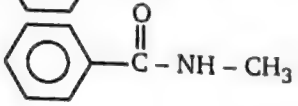
(a) 1 (b) 2 (c) 3 (d) 4

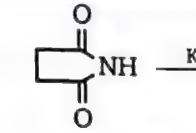
B.  ; Product (*A*) :

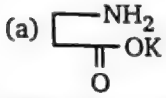
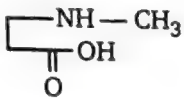
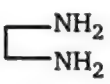
(a) $Ph-NH_2$ (b) $Ph-CH_2-NH_2$ (c) $Ph-NH-CH_3$ (d) 

C. Which of the following will not give Hoffmann bromamide reaction.

(a)  (b) 

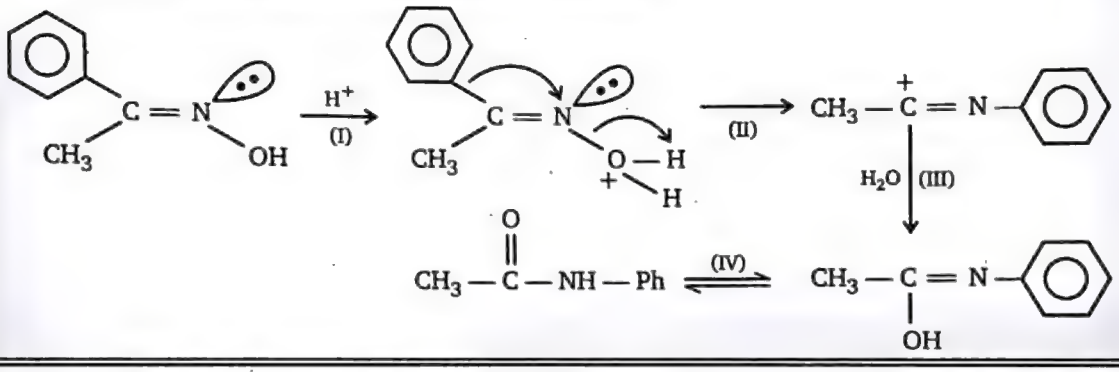
(c)  (d) 

D.  (A), Product (A) is :

(a) 
(b) 
(c) 
(d) None of these

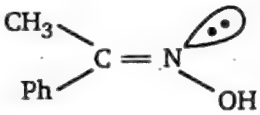
2. Comprehension

Given is mechanism of Beckmann rearrangement.



A. Rate determining step in Beckmann rearrangement :

(a) I (b) II (c) III (d) IV

B. 

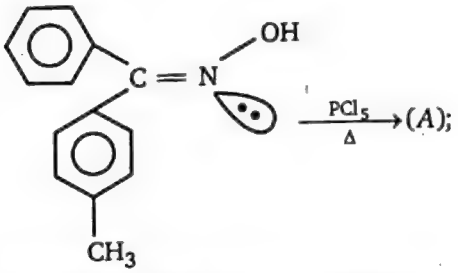
On treatment H_2SO_4 followed by hydrolysis in acidic medium above compound gives.

(a) CH_3-CO_2H, $Ph-NH_2$ (b) CH_3-NH_2, $Ph-CO_2H$

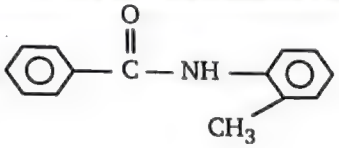
(c) $Ph-CH_2-NH_2 + Ph-CO_2H$ (d) $Ph-CO_2H + CH_3-CO_2H$

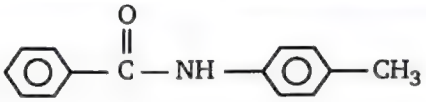
C. Which of the following reagent cannot used in Beckmann rearrangement ?

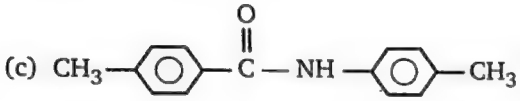
(a) TsOH (b) $R-SO_2Cl$ (c) BF_3 (d) $Ph-Li$

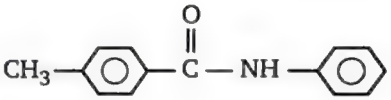
D. 

Product (A) of the above reaction is :

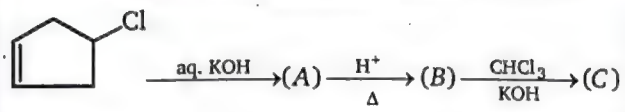
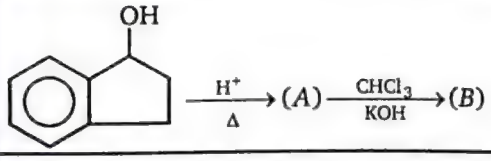
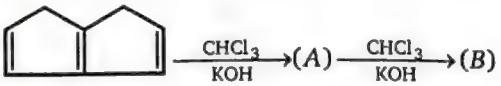
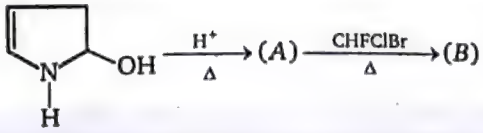
(a) 

(b) 

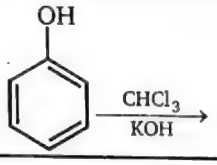
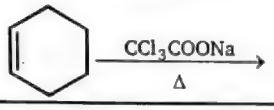
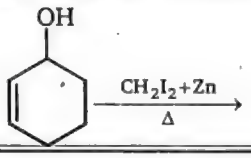
(c) 

(d) 

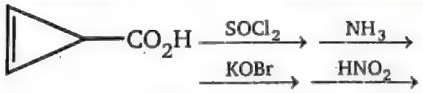
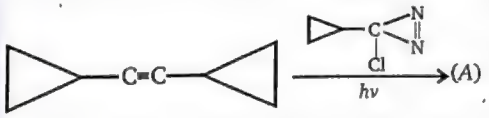
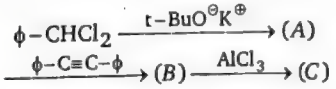
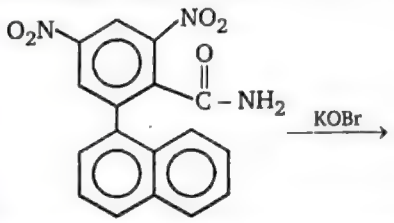
3. Match the column I and II.

	Column (I)		Column (II)
(a)		**(p)**	D.B.E. = even for product (Double bond equivalent)
(b)		**(q)**	D.B.E. = odd for product
(c)		**(r)**	Ring expansion takes place
(d)		**(s)**	Carbene will formed

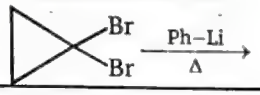
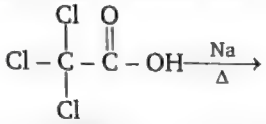
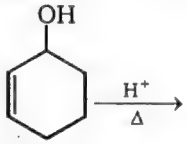
4. Match the column I and II.

	Column (I)		Column (II)
(a)		**(p)**	Reimer Tiemann reaction
(b)		**(q)**	Reimer Tiemann expansion (**or**) Abnormal RNT reaction
(c)		**(r)**	Simman-smith reaction.
(d)		**(s)**	Increase in carbon takes place

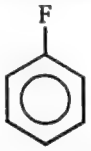
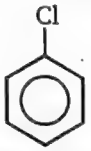
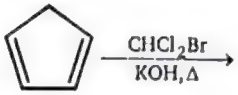
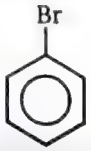
5. Match the column I and II.

	Column (I)		Column (II)
(a)		**(p)**	Aromatic compound will formed
(b)		**(q)**	Migration take place from carbon to electron deficient nitrogen
(c)		**(r)**	Carbene will formed in this reaction
(d)		**(s)**	N_2 will evolve.

6. Match the column I and II:

Column (I)		Column (II)	
Reaction		**Intermediate**	
(a)	$CHCl_3 + KOH \xrightarrow[\Delta]{}$	**(p)**	Carbocation
(b)		**(q)**	Carbanion
(c)		**(r)**	Free radical
(d)		**(s)**	Carbene

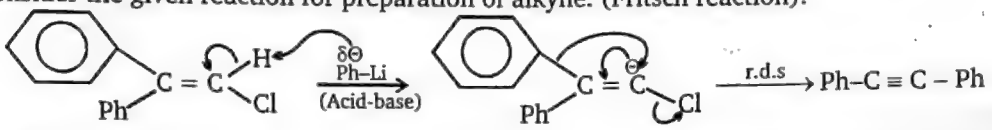
7. Matrix :

Column (I)		Column (II)	
Reaction		**Product**	
(a)		**(p)**	
(b)		**(q)**	
(c)		**(r)**	

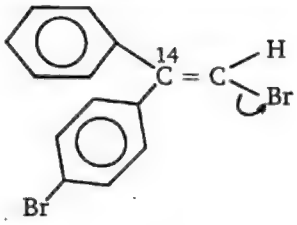
(d)		(s)	

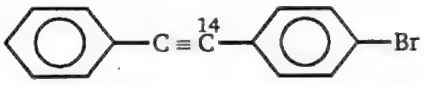
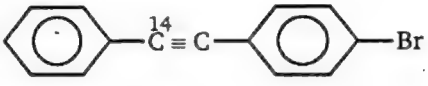
8. Comprehension

1. Consider the given reaction for preparation of alkyne. (Fritsch reaction).

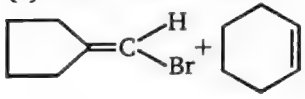


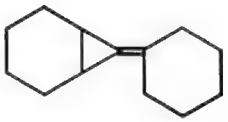
Anti group will migrate because of less steric hindrance.

A.  ; Major product (*A*) is :

(a)  (b) 

(c) $Ph - C \equiv C^{14} - Ph$ (d) $Ph - C \equiv C - Ph$

B.  $+ K^{\oplus}O^{\ominus}C(CH_3)_3 \xrightarrow[\Delta]{} (A)$, product (*A*) is :

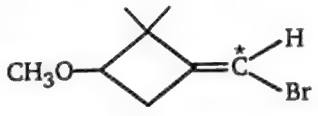
(a)  (b) 

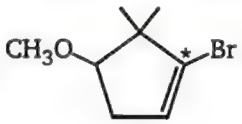
(c)  (d) 

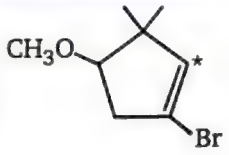
C. Rate of reaction when the halide ion:

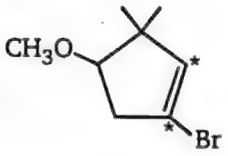
(a) $I^{\ominus} > Cl^{\ominus} > Br^{\ominus} > F^{\ominus}$ (b) $I^{\ominus} > Br^{\ominus} > Cl^{\ominus} > F^{\ominus}$

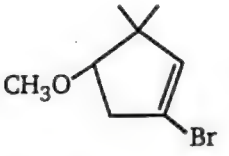
(c) $F^{\ominus} > Cl^{\ominus} > Br^{\ominus} > I^{\ominus}$ (d) $F^{\ominus} > Br^{\ominus} > Cl^{\ominus} > I^{\ominus}$

D.  (*A*) (Major) , Product (*A*) is : ($C^* = C^{14}$)

(a) 

(b) 

(c) 

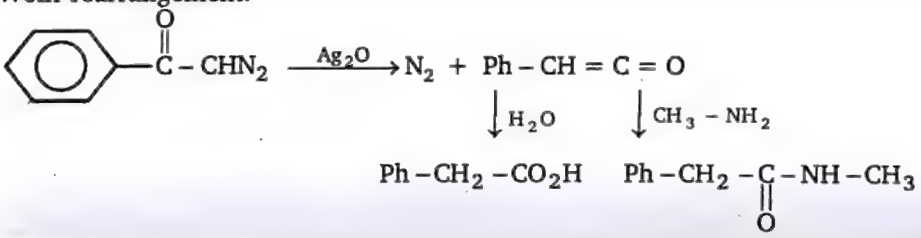
(d) 

9. Comprehension

Wolff rearrangement

When α-Diazoketones are photo-irradiated or heated at high temperature or reacted with silver oxide or silver salts at room temperature, they loose nitrogen and rearrange to form ketene.

The ketenes reacts rapidly with water, alcohol and amines. Therefore, the reactions called Wolff-rearrangement.



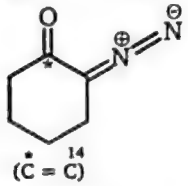
A. $Ph-\overset{\overset{O}{\|}}{\underset{14}{C}}-CHN_2 \xrightarrow[H_2O]{Ag_2O} (A)$, Product (A) is :

(a) $Ph-\overset{14}{C}H_2-CO_2H$

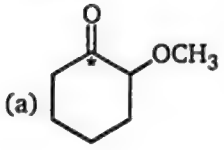
(b) $Ph-CH_2-\overset{14}{C}O_2H$

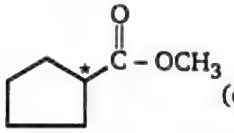
(c) $Ph-\overset{14}{C}O_2H$

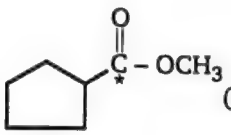
(d) $Ph-CO_2H$

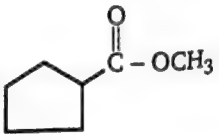
B. 

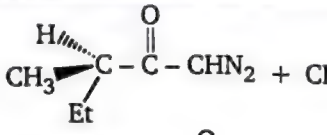
$\xrightarrow[h\nu]{CH_3OH}$ (A) (Major), Product (A) is :

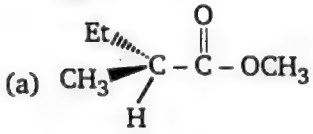
(a) 

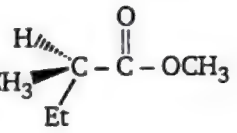
(b) 

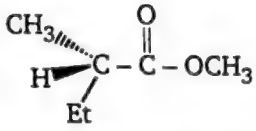
(c) 

(d) 

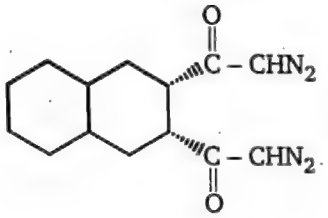
C.  $\xrightarrow{Ag_2O}$ Major product of the reaction is :

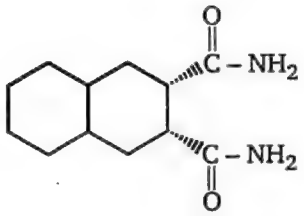
(a) 

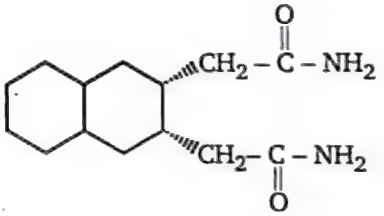
(b) 

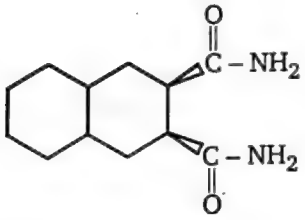
(c) 

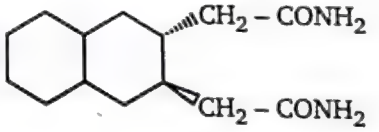
(d) None of these

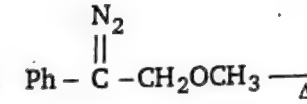
D.  $\xrightarrow[NH_3]{Ag_2O}$ (*A*) (Major) , Product (*A*) is :

(a) 

(b) 

(c) 

(d) 

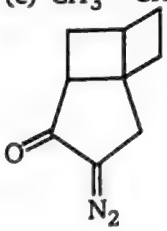
E.  $\xrightarrow[\Delta]{}$ (*A*) 90% , product (*A*) is :

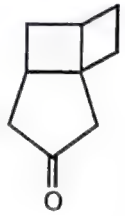
(a) $Ph - CH = CH - OH$

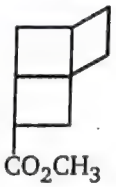
(b) $Ph - CH = CH - OCH_3$

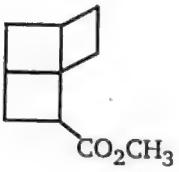
(c) $CH_3 - CH = CH - O - PH$

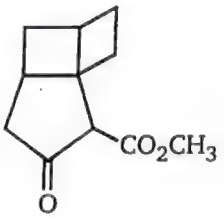
(d) $CH_3 - CH = CH - OH$

F.  $\xrightarrow[CH_3OH]{h\nu}$ (*A*) , Product (*A*) is :

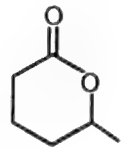
(a) 

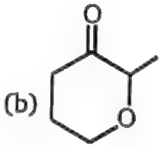
(b) 

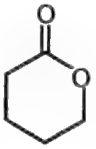
(c) 

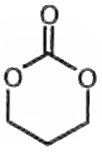
(d) 

G. $HO-CH_2-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-CHN_2 \xrightarrow[\Delta]{Ag_2O} (A)$, Product (*A*) is :

(a) 

(b) 

(c) 

(d) 

ANSWERS — LEVEL 2

1. A – d, ; B – a; C – d, ; D – a,

2. A – b; B – b; C – d; D – b

3. a – p, r, s; b – q, r, s; c – q, r, s; d – p, r, s

4. a – q, s; b – p, s; c – s; d – r, s

5. a – p, q, s; b → p, r, s ; c – p, r ; d – p, q

6. a – q, s; b – q, s; c – q, s; d – p

7. a – q; b – p; c – q; d – q

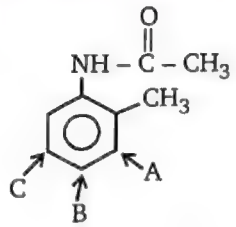
8. A – a; B – c; C – b; D – b

9. A – b; B – c; C – d; D – b; E – b; F – b; G – c

12 AROMATIC COMPOUNDS

LEVEL-1

1.



Identify the position where electrophilic aromatic substitution (EAS) is most favourable.

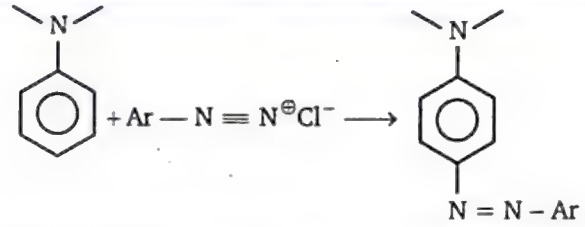
(a) A
(b) B
(c) C
(d) A and C

2.

(a) (b) (c) (d)

Correct order of rate of EAS (electrophilic aromatic substitution) is :

(a) $c > b > a > d$
(b) $c > d > a > b$
(c) $a > b > c > d$
(d) $c > d > b > a$

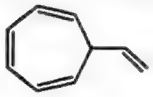
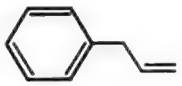
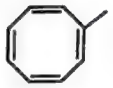
3. 

Above (C—N) coupling reaction take place at :

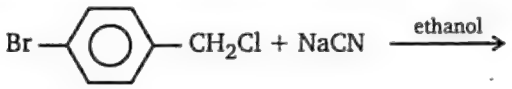
(a) low pH (b) Intermediate pH

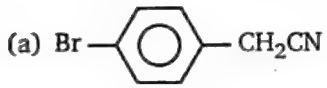
(c) high pH (d) any pH

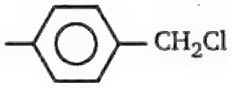
4. Which of the following has the lowest heat of combustion ?

(a)  (b)  (c)  (d) 

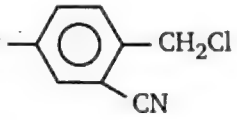
5. The product obtained from the reaction is :

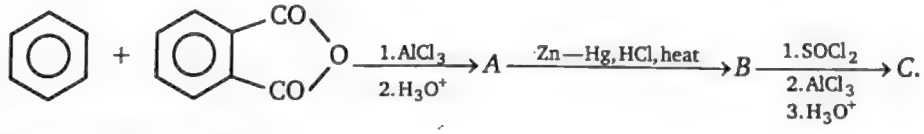


(a) 

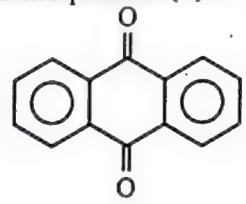
(b) 

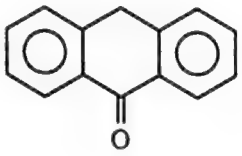
(c) 

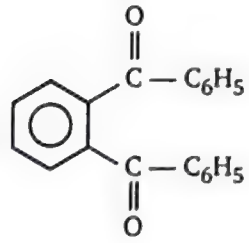
(d) 

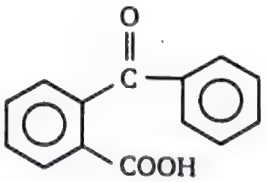
6. 

The end product (*C*) is :

(a) 

(b) 

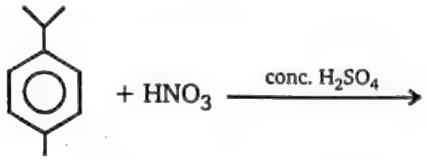
(c) 

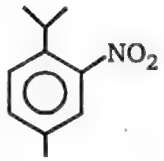
(d) 

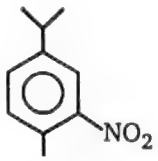
7. How many benzylic hydrogens are present in the hydrocarbon shown below ?

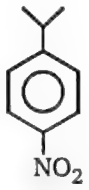
(a) 3 (b) 4 (c) 5 (d) 6 (e) 8

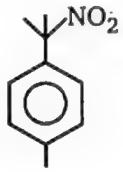
8. The major product formed in the reaction is :



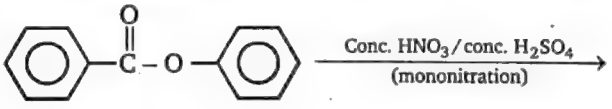
(a) 

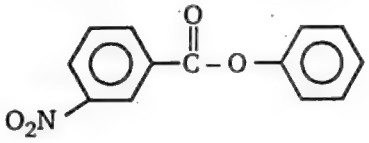
(b) 

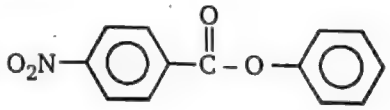
(c) 

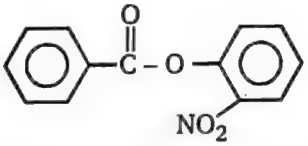
(d) 

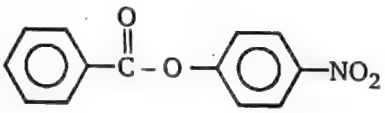
9. The major product formed in the reaction is :



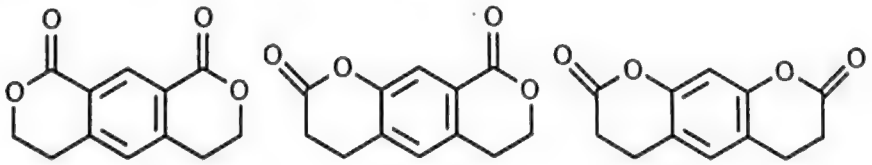
(a) 

(b) 

(c) 

(d) 

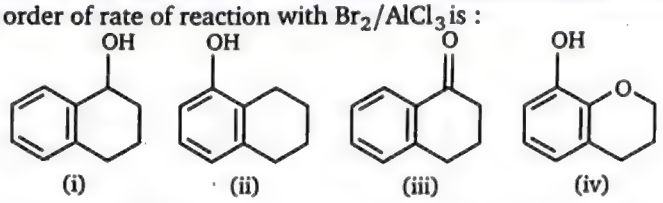
10. Increasing order of rate of reaction with HNO_3/H_2SO_4 is :



(i) (ii) (iii)

(a) iii < ii< i (b) ii < iii < i (c) i < iii < ii (d) i < ii < iii

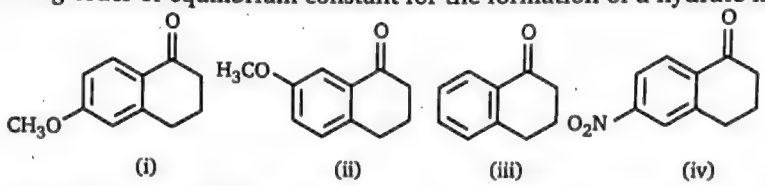
11. Increasing order of rate of reaction with $Br_2/AlCl_3$ is :



(i) (ii) (iii) (iv)

(a) iii < i < ii < iv (b) iv < ii < i < iii (c) ii < iv < iii < i (d) iv < ii < iii < i

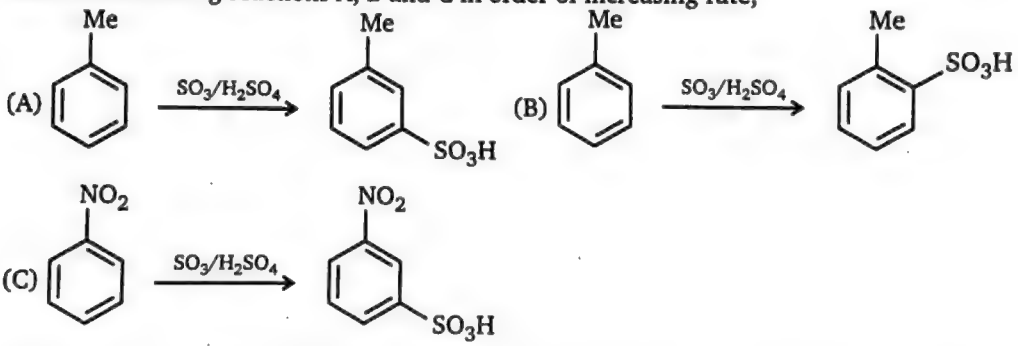
12. Increasing order of equilibrium constant for the formation of a hydrate is :



(i) (ii) (iii) (iv)

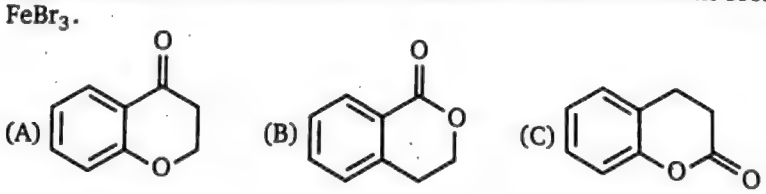
(a) i < ii < iii < iv (b) iv < ii < i < iii (c) ii < iv < iii < i (d) iv < ii < iii < i

13. Rank the following reactions A, B and C in order of increasing rate,



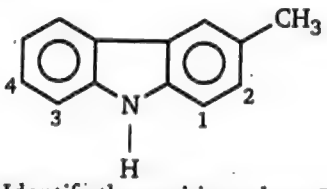
(a) B > A > C (b) B > C > A (c) A > B > C (d) A > C > B

14. Rank in order of increasing rate of reaction towards EAS with bromine in the presence of $FeBr_3$.



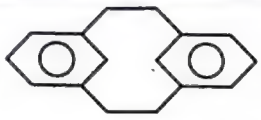
(a) B < A < C (b) B < C < A
(c) A < B < C (d) A < C < B

15.

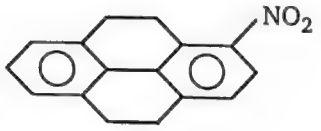


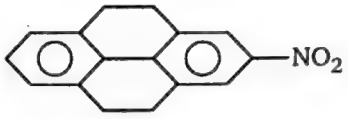
Identify the position where E.A.S. can take place.

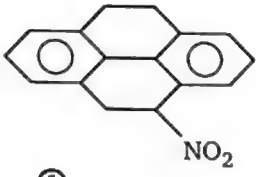
(a) 1 (b) 2 (c) 3 (d) 4

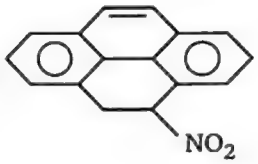
16.  $\xrightarrow[\Delta]{H^+}(A)\xrightarrow[\Delta]{HNO_3}(B)$.

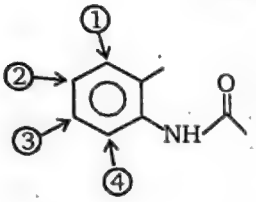
Product (*B*) in the above reactions is:

(a) 

(b) 

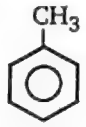
(c) 

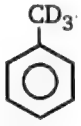
(d) 

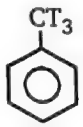
17.  Sulphonation is most favourable at the carbon number... .

(a) 1 (b) 2 (c) 3 (d) 4

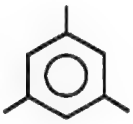
18. Arrange the following in decreasing order of reactivity towards EAS (electrophilic aromatic substitution)


(*a*)

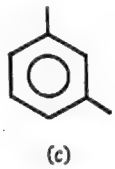

(*b*)

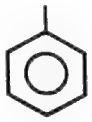

(*c*)

(a) $a > b > c$ (b) $c > b > a$ (c) $a > c > b$ (d) $c > a > b$

19. 
(*a*)


(*b*)


(*c*)

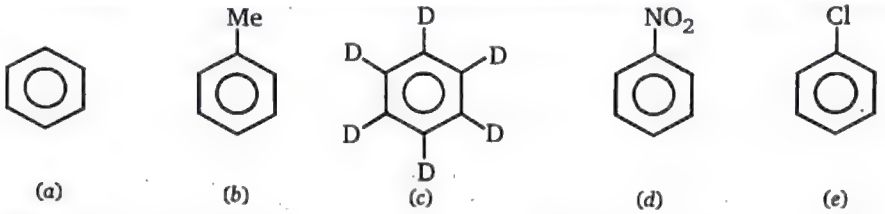

(*d*)

Decreasing order of rate of electrophilic aromatic substitution is :

(a) $a > b > c > d$ (b) $a > c > b > d$

(c) $b > a > c > d$ (d) $b > c > a > d$

20. Arrange the following in increasing order of rate of Nitration:

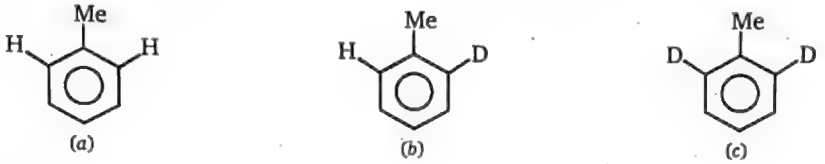


(a) (b) (c) (d) (e)

(a) $b < c < a < d < e$ (b) $d < e < a = c < b$

(c) $d < a = c < e < b$ (d) $a < c < b < e < d$

21.

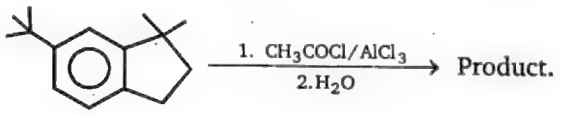


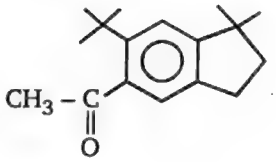
(a) (b) (c)

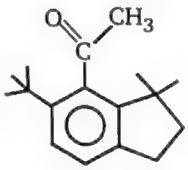
The rate of nitration will be:

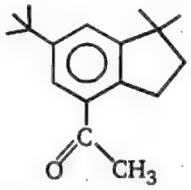
(a) $a > b > c$ (b) $a > c > b$ (c) $a = b = c$ (d) $c > a > b$

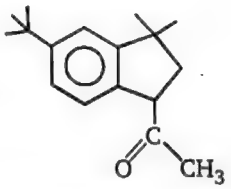
22. The major product of the reaction is



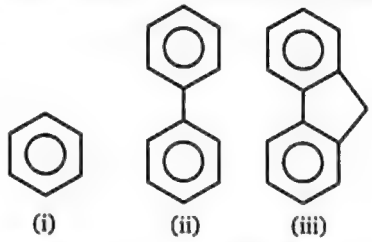
(a) 

(b) 

(c) 

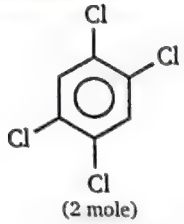
(d) 

23. Arrange in their decreasing order of rate of electrophilic aromatic substitution :

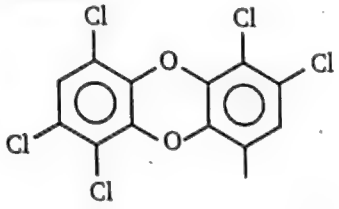


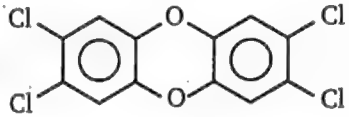
(i) (ii) (iii)

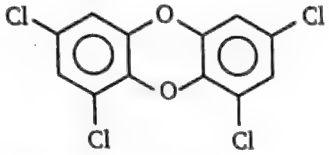
(a) i > ii > iii (b) iii > ii > i (c) iii > i > ii (d) i > iii > ii

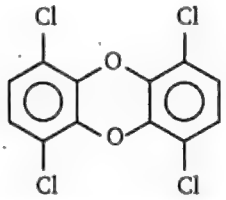
24.  + HO^- (4 mole) ⟶ (*A*) (major) ; Product (*A*) of the given reaction is :

(2 mole)

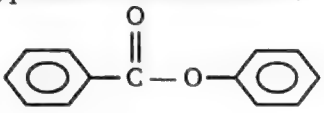
(a) 

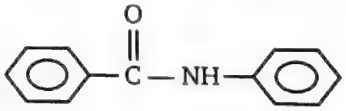
(b) 

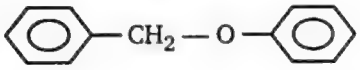
(c) 

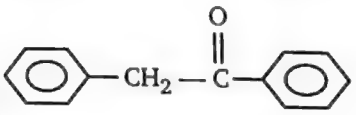
(d) 

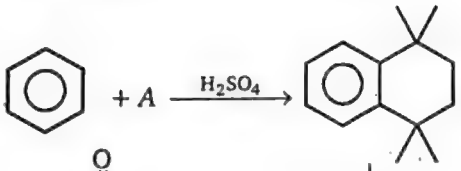
25. In which of the following compound electrophilic aromatic substitution take place in phenyl ring present in left hand side ?

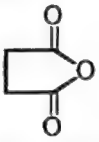
(a) 

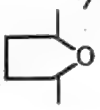
(b) 

(c) 

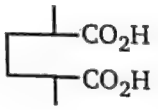
(d) 

26.  ; Reactant (*A*) is :

(a) 

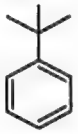
(b) 

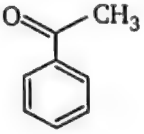
(c) 

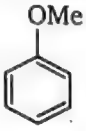
(d) 

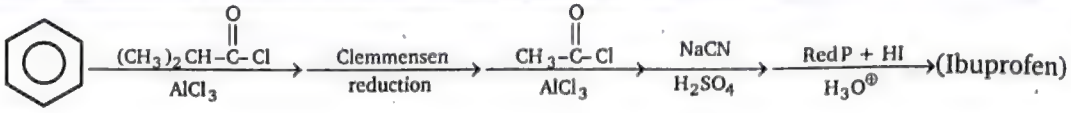
27. Which of the following compounds is the slowest to react with nitrosonium ion (NO^+)?

(a) 

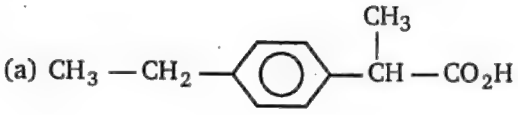
(b) 

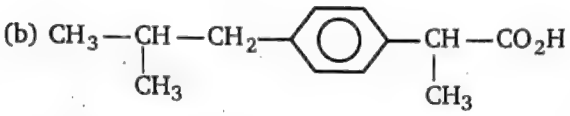
(c) 

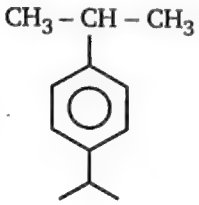
(d) 

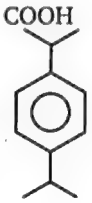
28. 

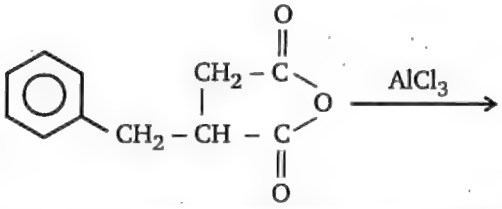
Ibuprofen is :

(a) 

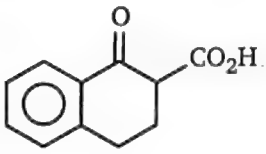
(b) 

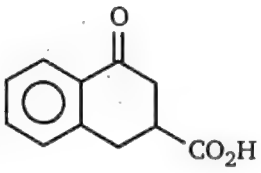
(c) 

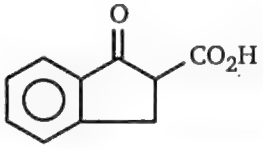
(d) 

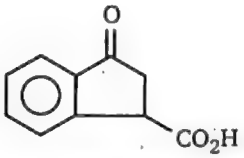
29. 

What is the major product of above Friedel-Craft reaction ?

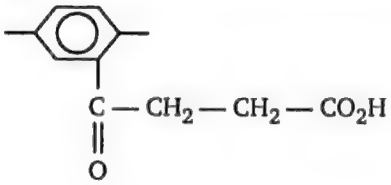
(a) 

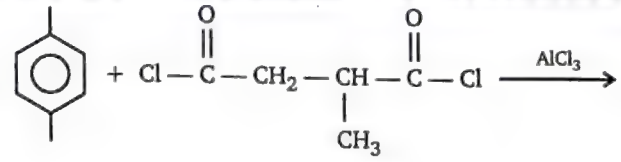
(b) 

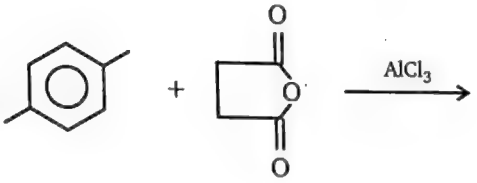
(c) 

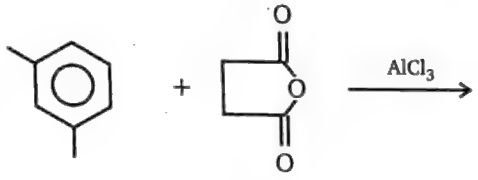
(d) 

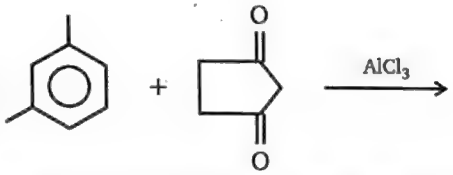
30. What combination of acid chloride or anhydride and arene would you choose to prepare given compound ?



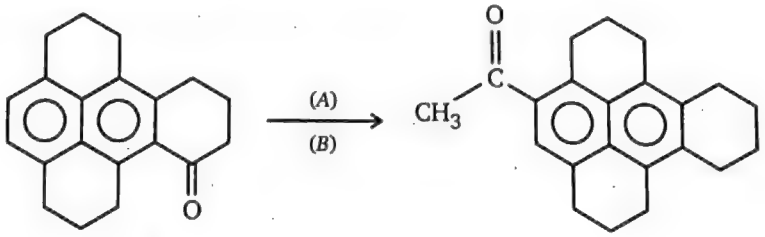
(a) 

(b) 

(c) 

(d) 

31. In the given conversion best yield will obtained with :



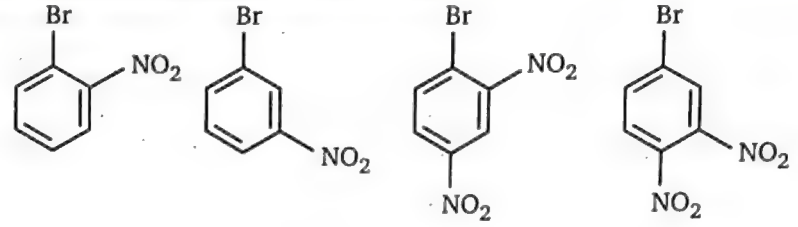
(a) $A = CH_3-\overset{O}{\overset{\|}{C}}-Cl, AlCl_3$, $B = Zn(Hg)$, HCl

(b) $A = Zn(Hg), HCl$, $B = CH_3-\overset{O}{\overset{\|}{C}}-Cl$, $AlCl_3$

(c) $A = CH_3-CH_2-Cl$, $AlCl_3$, $B = Zn(Hg)$, HCl

(d) $A = NH_2-NH_2/HO^-, D$, $B = CH_3-CH_2-Cl$, $AlCl_3$

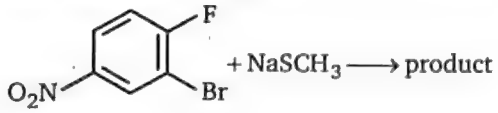
32. Rank the following in order of decreasing rate of reaction with alkoxide ion ($CH_3CH_2O^-$) in a nucleophilic aromatic substitution reaction :



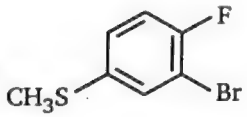
1 2 3 4

(a) 3 > 4 > 1 > 2 (b) 3 > 4 > 2 > 1 (c) 2 > 1 > 4 > 3 (d) 4 > 3 > 2 > 1

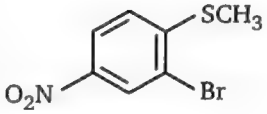
33. Identify the principal organic product of the following reaction.



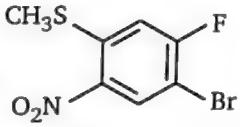
(a)



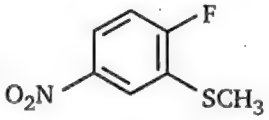
(b)



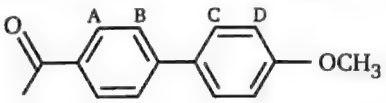
(c)



(d)

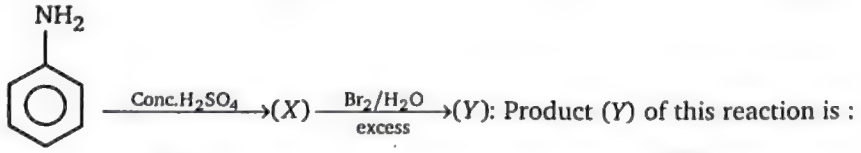


34. Which position will be attacked most rapidly by the nitronium ion $(-NO_2)^+$ when the compound undergoes nitration with HNO_3/H_2SO_4 :



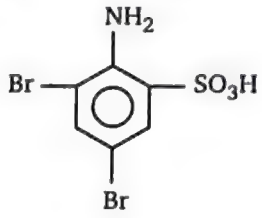
(a) A (b) B (c) C (d) D

35.

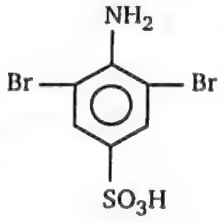


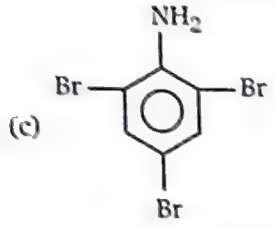
: Product (Y) of this reaction is :

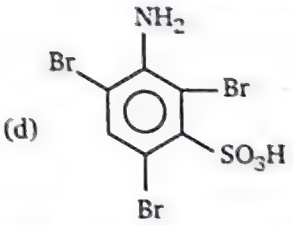
(a)



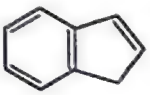
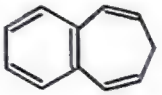
(b)

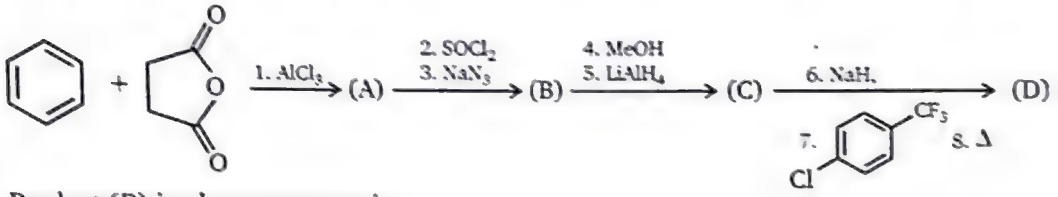


(c) 

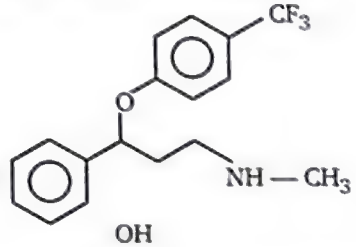
(d) 

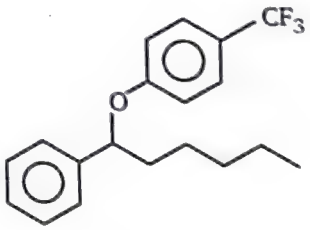
36. All the hydrocarbons shown are very weak acids. One, however, is far more acidic than the others. Which one is the strongest acid ?

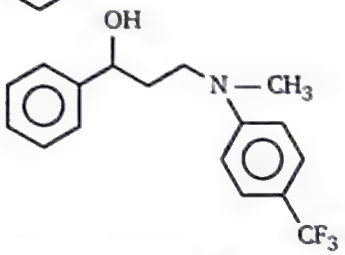
(a)  (b)  (c)  (d) 

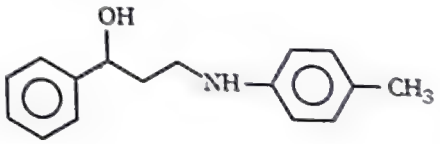
37. 

Product (*D*) in above sequence is :

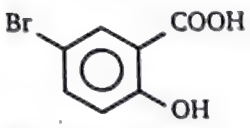
(a) 

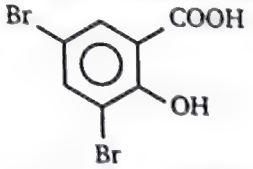
(b) 

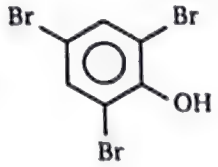
(c) 

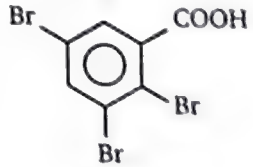
(d) 

38. The action of bromine water (excess) on salicylic acid results in the formation of :

(a) 

(b) 

(c) 

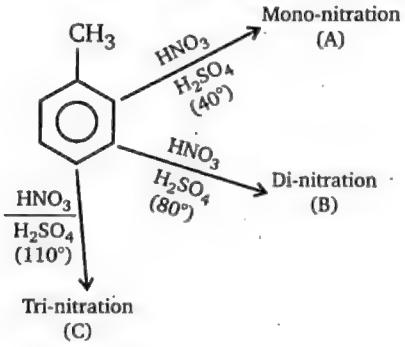
(d) 

39. What is the correct order of *o*/*p* ratio when E^+ attacks the following system ?

PhF (A) PhCl (B) PhBr (C) PhI (D)

(a) A < B < C < D (b) A = B = C = D (c) D < C < B < A (d) D < B < A < C

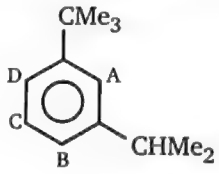
40. How many products are capable of beings formed from toluene in each of following reaction ?



(a) A = 3, B = 6, C = 8 (b) A = 3, B = 6, C = 6

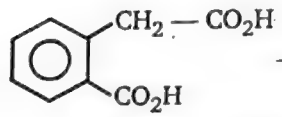
(c) A = 3, B = 6, C = 10 (d) A = 3, B = 4, C = 6

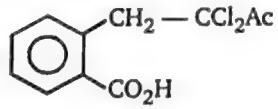
41. Nitration takes place at the which position of the given compound ?

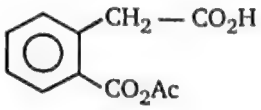


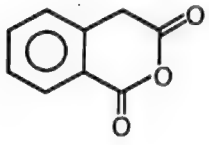
(a) A (b) B

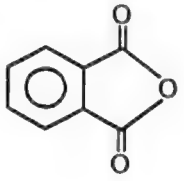
(c) C (d) D

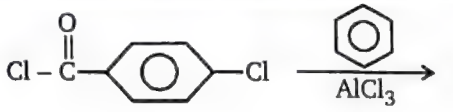
42.  , Indentify the product.

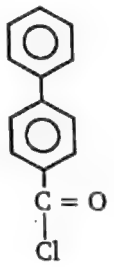
(a) 

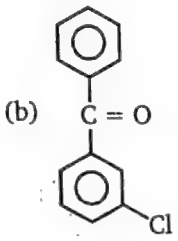
(b) 

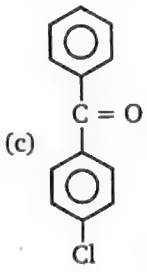
(c) 

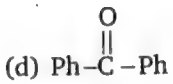
(d) 

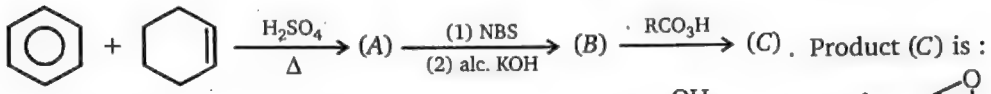
43.  (*A*) ; Unknown (*A*) is :

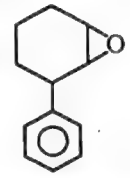
(a) 

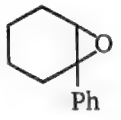
(b) 

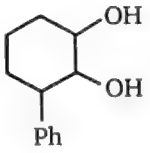
(c) 

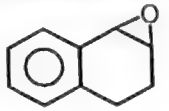
(d) 

44.  Product (*C*) is :

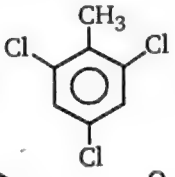
(a) 

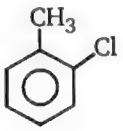
(b) 

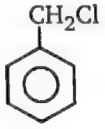
(c) 

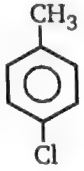
(d) 

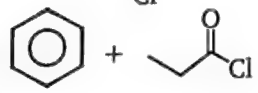
45. The reaction of toluene with chlorine in the presence of light gives :

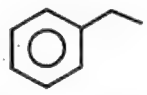
(a) 

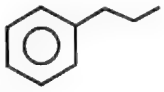
(b) 

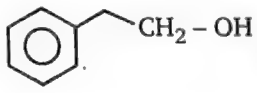
(c) 

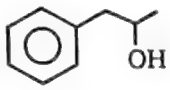
(d) 

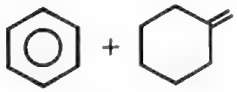
46.  (*B*), Product (*B*) in this reaction is :

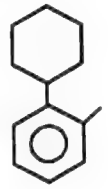
(a) 

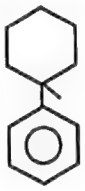
(b) 

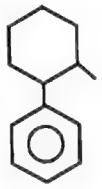
(c) 

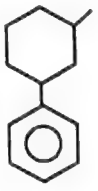
(d) 

47.  Suitable product of this reaction is :

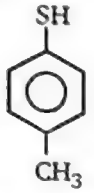
(a) 

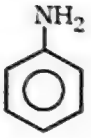
(b) 

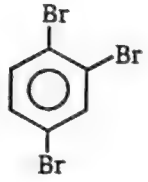
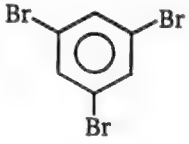
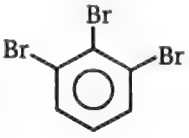
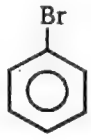
(c) 

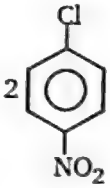
(d) 

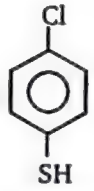
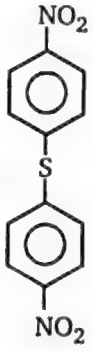
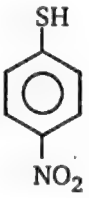
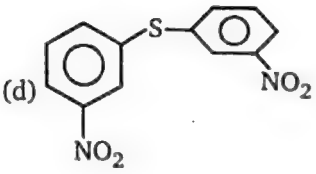
48.  $\xrightarrow{NaSH}$ A; Product (A) of the reaction is :

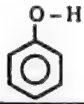
(a)  (b) no reaction (c)  (d) 

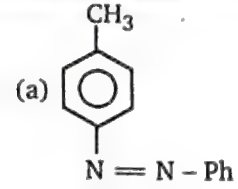
49.  $\xrightarrow[H_2O]{Br_2}$ (A) $\xrightarrow[(ii)\ H_3PO_2]{(i)\ NaNO_2/HCl}$ (B), Product (B) in this reaction is :

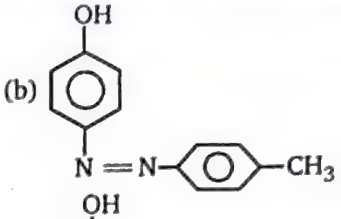
(a)  (b)  (c)  (d) 

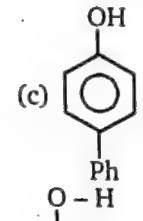
50. 2  $\xrightarrow{Na_2S}$ (A), Product (A) in this reaction is :

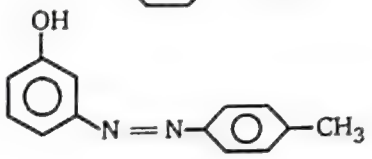
(a)  (b)  (c)  (d) 

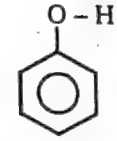
51.  $\xrightarrow{NaNO_2/HCl}$ (A) $\xrightarrow[\text{(mild basic medium)}]{}$  (B), (Major) Product (B) of this reaction is :

(a) 

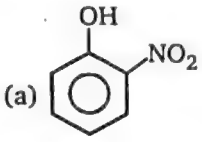
(b) 

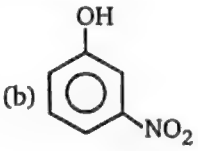
(c) 

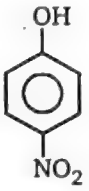
(d) 

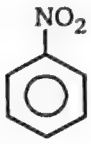
52.  $\xrightarrow{HNO_3/H_2SO_4}$ (*A*) (more volatile) + (*B*) (less volatile)

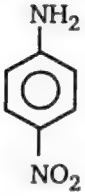
Product (*A*) of the above reaction is :

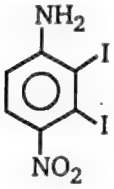
(a) 

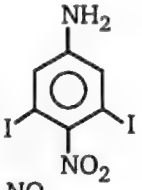
(b) 

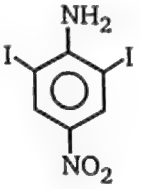
(c) 

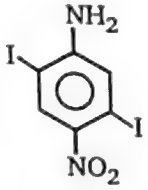
(d) 

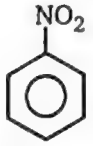
53.  $\xrightarrow[(56-63\%)]{2ICl}$ *x* + 2HCl; Major product (*x*) in this reaction is :

(a) 

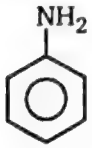
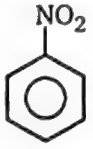
(b) 

(c) 

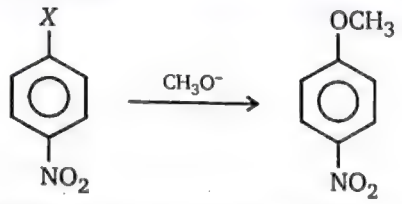
(d) 

54.  $\xrightarrow[H_2SO_4]{HNO_3}$  , van't-Hoff factor (*i*) for this reaction is :

(a) 2 (b) 3 (c) 4 (d) 5

55.  $\xrightarrow{?}$  , the missing reagent is :

(a) CF_3CO_3H (b) H_2SO_4 (c) LAH (d) $NaBH_4$

56. 

above reaction is an example of Nucleophilic aromatic substitution. Which of the following halide (–*X*) is most readily replaced.

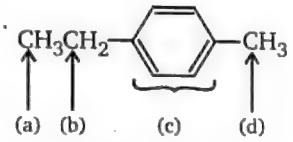
(a) – F (b) – Cl (c) – Br (d) – I

57. When comparing the hydrogenation of benzene with that of a hypothetical 1, 3, 5-cyclohexatriene, benzene _____ than the cyclohexatriene.

(a) absorbs 152 kJ /mol more heat (b) gives off 152 kJ/mol more heat

(c) absorbs 152kJ /mol less heat (d) gives off 152 kJ/mol less heat

58. Which of the following hydrogens is most easily abstracted on reaction with bromine free radicals, Br• ?



(a) a (b) b (c) c (d) d

59. The electrophilic aromatic substitution proceeds through a :

(a) free radical (b) sigma complex (c) benzyne (d) carbene

60. Which of the following substitution of benzene is ortho-para in electrophilic substitution and ortho-para in nucleophilic substitution ?

(a) $-NO_2$ (b) – NO

(c) $-SO_3H$ (d) $-SO_2Me$

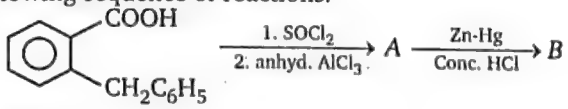
61. The number of possible isomers of dichloronitrobenzene is :

(a) 3 (b) 4 (c) 6 (d) 8

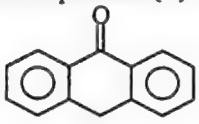
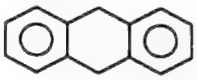
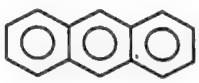
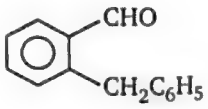
62. Which of the following is not an aromatic compound ?

(a)  (b)  (c)  (d) 

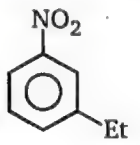
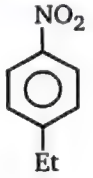
63. Consider the following sequence of reactions.



The end product (*B*) is:

(a)  (b)  (c)  (d) 

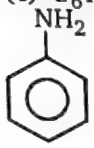
64. $Ph-NO_2 + Et-Cl \xrightarrow{AlCl_3} (A)$, Product (A) of the given reaction is :

(a) Ph – NH – Et (b) no–reaction (c)  (d) 

65. In nitration of benzene by mixed acid the rate of reaction will be :

(a) $C_6H_6 = C_6D_6 = C_6T_6$ (b) $C_6H_6 > C_6D_6 > C_6T_6$

(c) $C_6H_6 = C_6D_6 > C_6T_6$ (d) $C_6H_6 < C_6D_6 < C_6T_6$

66.  $\xrightarrow{H_2SO_5}$ (A) $\xrightarrow[EtO^-/\Delta]{Ph-CH_2CN}$ (B) ; Product (B) is :

(a) $Ph-N=\underset{\displaystyle Ph}{\overset{\displaystyle |}{C}}-CN$ (b) $Ph-N=C-Ph$

(c) $Ph-N=N-Ph$ (d) $Ph-CH=CH-Ph$

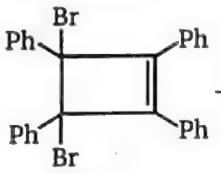
67. Which of the following ring compounds obeys Huckel's rule ?

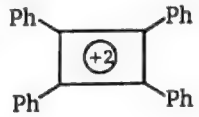
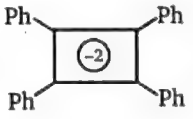
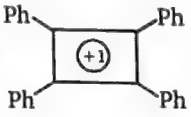
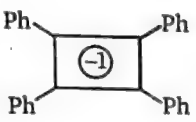
(a) $C_4H_4^{-1}$ (b) $C_4H_4^{+1}$ (c) $C_4H_4^{-2}$ (d) C_4H_4

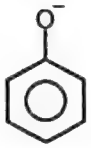
68. Nitration of which of the following reactant gives maximum % of meta product (using HNO_3/H_2SO_4) ?

(a) Toluene (b) Aniline

(c) Benzene (d) Isopropyl benzene

69.  $\xrightarrow{2AgBF_4}$ (x) $2BF_4^-$; compound (x) will be :

(a)  (b)  (c)  (d) 

70.  $\xrightarrow[(2)\ H^{\oplus}]{(1)\ CO_2}$ (A)

Which of the following is true statement about the reaction ?

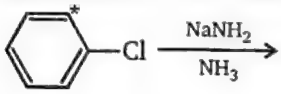
(a) Ortho isomer is major if PhONa is used

(b) Para isomer is major if PhOK is used

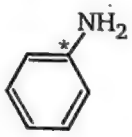
(c) Product formed is further used for preparation of drug aspirin

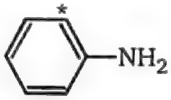
(d) All of these

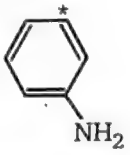
71. Two benzyne intermediates are likely to be formed equally. Reaction with amide ion can occur in two different directions with each benzyne, giving three possible products. They are formed in a 1 : 2 : 1 ratio. Asterisk (*) refers to ^{14}C.

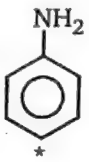


(A) Product major; product (*A*) is :

(a) 

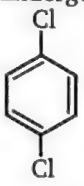
(b) 

(c) 

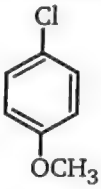
(d) 

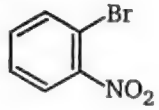
72. Which one of the following undergoes nucleophilic aromatic substitution at the fastest rate ?

(a) 

(b) 

(c) 

(d) 

73. For the reaction ; ? 

; the best combination of reactants is :

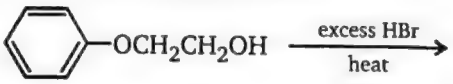
(a) $C_6H_5Br + HNO_3$, H_2SO_4 (b) $C_6H_5Br + H_2SO_4$, heat
(c) $C_6H_5NO_2 + Br_2$, $FeBr_3$ (d) $C_6H_5NO_2 + HBr$

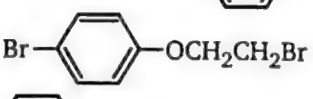
74. The action of $AlCl_3$ in Friedel Craft's reaction is:
(a) to absorb HCl (b) to release HCl
(c) to produce electrophile (d) to produce nucleophile

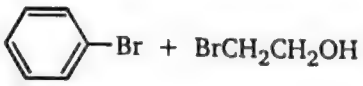
75. *n*-Butylbenzene on oxidation with hot alkanine $KMnO_4$ gives :
(a) benzoic acid (b) butanoic acid (c) benzyl alcohol (d) benzaldehyde

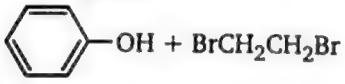
76. Which sequence of steps describes the best synthesis of 2-phenylpropene ?
(a) Benzene + 2-chloropropene , $AlCl_3$
(b) 1. Benzaldehyde ($C_6H_5CH=O$) + CH_3CH_2MgBr, diethyl ether
2. H_3O^+ 3. H_2SO_4, heat
(c) 1. Bromobenzene + Mg, diethyl ether 2. Propanal ($CH_3CH_2CH=O$)
3. H_3O^+ 4. H_2SO_4, heat
(d) 1. Bromobenzene + Mg, diethyl ether 2. Acetone [$(CH_3)_2C=O$]
3. H_3O^+ 4. H_2SO_4, heat

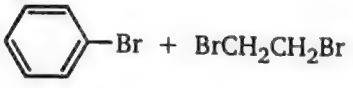
77. What are the products of the following reaction ?



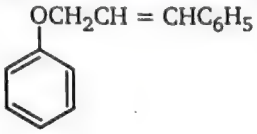
(a) 

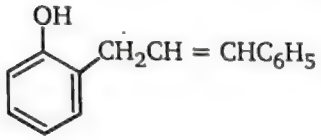
(b) 

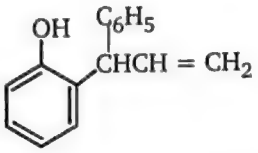
(c) 

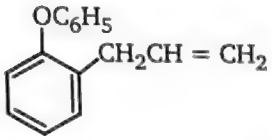
(d) 

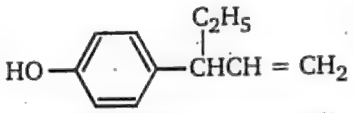
78. What is the product obtained by heating the following allylic ether of phenol ?



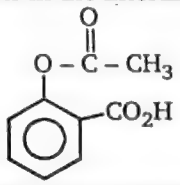
(a) 

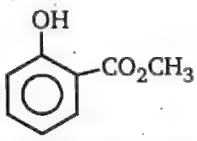
(b) 

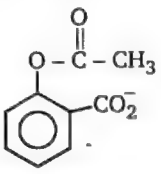
(c) 

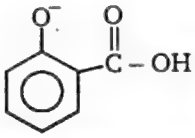
(d) 

79. When you ingest aspirin, it passes through your stomach, which has an acidic pH, before traveling through the basic environment of your intestine. Provide the structure form as it exists in the intestine.

(a) 

(b) 

(c) 

(d) 

80. Which of the following sets of reagents, used in the order shown, would be enable for the preparation of *p*-chlorophenol from *p*-chloronitrobenzene ?

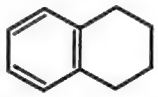
(a) 1. Fe, HCl ; 2. NaOH ; 3. $NaNO_2$, H_2SO_4 ; 4. H_3PO_2

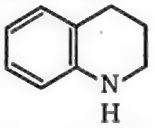
(b) 1. Fe, HCl ; 2. NaOH ; 3. $NaNO_2$, H_2SO_4 ; 4. H_2O, heat

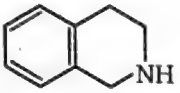
(c) 1. Fe, HCl ; 2. NaOH ; 3. $NaNO_2$, H_2SO_4 ; 4. ethanol

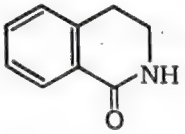
(d) 1. NaOH, heat ; 2. HCl

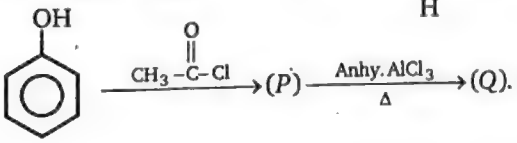
81. Which one of the following compounds undergoes bromination of its aromatic ring (electrophilic aromatic substitution) at the fastest rate ?

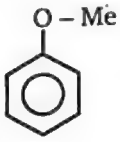
(a) 

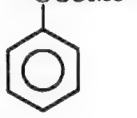
(b) 

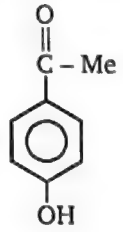
(c) 

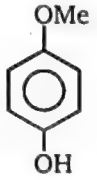
(d) 

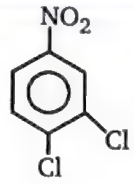
82.  (*Q*). Product (*Q*) in this reaction is :

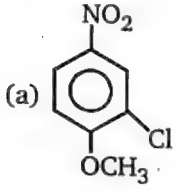
(a) 

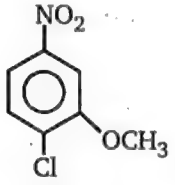
(b) 

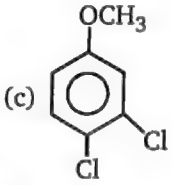
(c) 

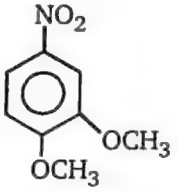
(d) 

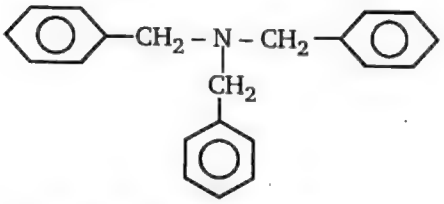
83.  $\xrightarrow[CH_3OH,\Delta]{CH_3O^-}$ (*P*) (major) ; The product (*P*) will be :

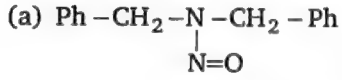
(a) 

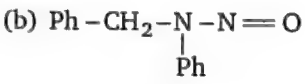
(b) 

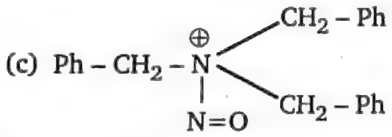
(c) 

(d) 

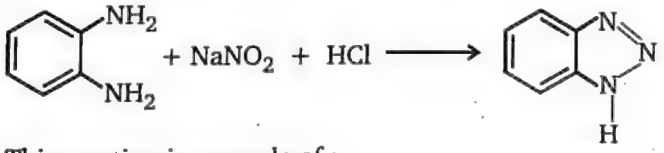
84.  $\xrightarrow[HCl,\ 90°C]{NaNO_2,}$ (*A*) ; Product (*A*) is :

(a) 

(b) 

(c) 

(d)

85. 

This reaction is example of :

(a) Intermolecular C – N coupling (b) Intramolecular C – N coupling

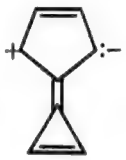
(c) Intermolecular N – N coupling (d) Intramolecular N – N coupling

86. The total number of isomeric trimethylbenzene is :

(a) 2 (b) 3 (c) 4 (d) 6

87. Caliene, C_7H_6, is expected to be a fairly polar aromatic molecule. Which of the following resonance forms contributes to the greatest extent towards the real structure (resonance hybrid) of the molecule ?

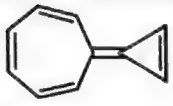
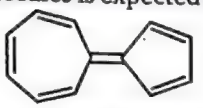
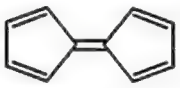
(a) 

(b) 

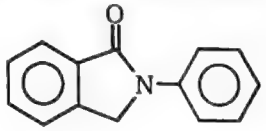
(c) 

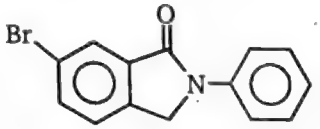
(d) 

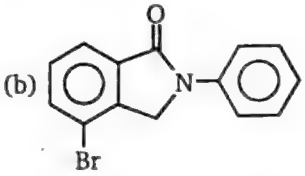
88. Which of the following molecules is expected to have the greatest resonance stabilization ?

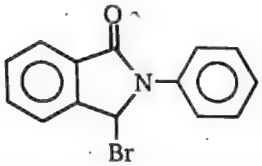
(a)  (b)  (c)  (d) 

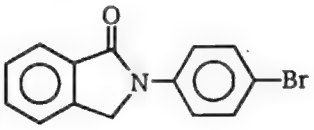
89. In the reaction given below, the major product formed is :



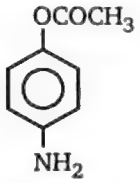
(a) 

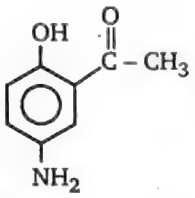
(b) 

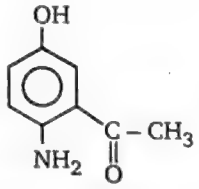
(c) 

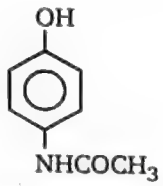
(d) 

90. *p*-aminophenol reacts with one equivalent of acetyl chloride in the presence of pyridine to give mainly :

(a) 

(b) 

(c) 

(d) 

91. Which of the following reactions can be used to prepare acetophenone ?

(a) $C_6H_6 + CH_3COCl \xrightarrow[2\,H_2O]{1.\,AlCl_3}$ (b) $(C_6H_5COO)_2Ca + (CH_3COO)_2Ca \xrightarrow{heat}$

(c) $C_6H_6CN \xrightarrow[2\,H_3O^+]{1.\,CH_3MgI.}$ (d) All of these

92. Consider the following sequence of reactions.

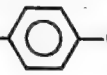
$$C_6H_6 + CH_3CH=CH_2 \xrightarrow[heat]{H_3PO_4} A \xrightarrow[2.\,H_3O^+,\ heat]{1.\,O_2,heat} B + C$$

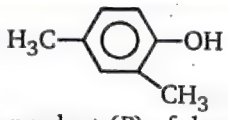
The products (*B*) and (*C*) are :

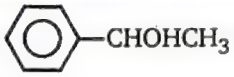
(a) benzaldehyde and acetaldehyde (b) benzoic acid and acetic acid

(c) phenol and propionaldehyde (d) phenol and acetone

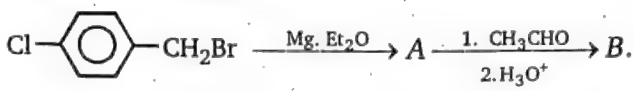
93. An organic compound having the molecular formula $C_8H_{10}O$ on being heated with I_2 and dilute NaOH gives a yellow precipitate. The expected compound is :

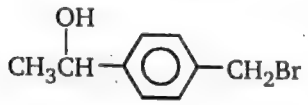
(a) $C_6H_5CH_2CH_2OH$ (b) CH_3–  –CH_2OH

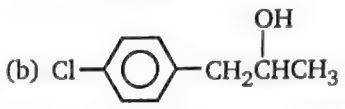
(c) 

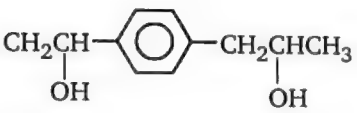
(d) 

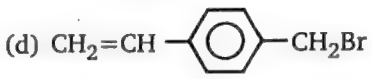
94. The product (*B*) of the reaction sequence is :



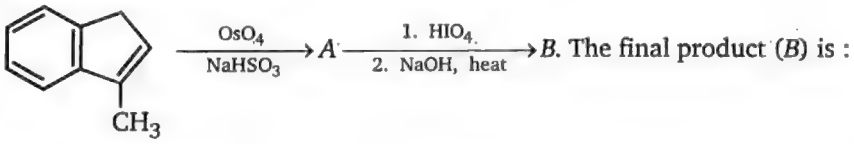
(a) 

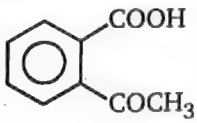
(b) 

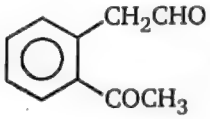
(c) 

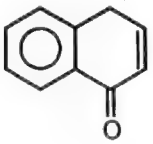
(d) 

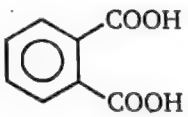
95. Consider the following sequence of reactions.



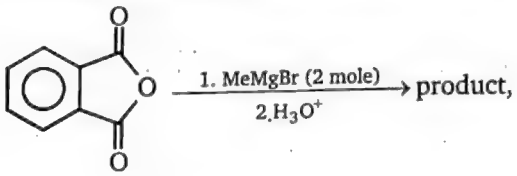
(a) 

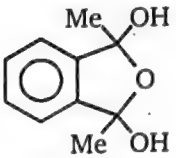
(b) 

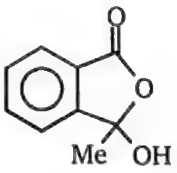
(c) 

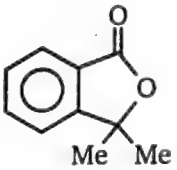
(d) 

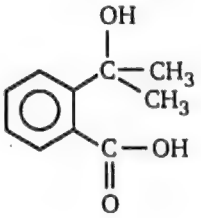
96. For the reaction, the product expected is :



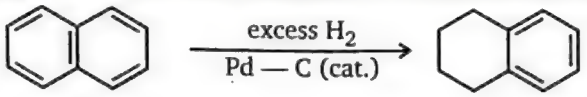
(a) 

(b) 

(c) 

(d) 

97. Hydrogenation of naphthalene (*P*) with excess hydrogen gas stops cleanly at 1, 2, 3, 4-tetrahydronaphthalene (*Q*). What conclusion can be drawn from this experiment ?



(*P*) (*Q*)

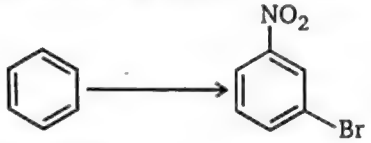
(a) the hydrogenation of *P* is exothermic

(b) one aromatic ring of *P* is more reactive than the aromatic ring of *Q*

(c) one aromatic ring of *P* is less reactive than the other ring of *Q*

(d) reduction of the first C = C of *P* is faster than reduction of the second or third C = C

98. Suggest the best reaction conditions for the synthesis shown below.



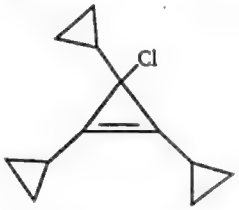
(a) (1) HNO_3, H_2SO_2; then (2) Br_2

(b) (1) Br_2; then (2) HNO_3, H_2SO_2

(c) (1) CH_3Br, $AlBr_3$; then (2) HNO_3, H_2SO_3

(d) HNO_3, H_2SO_2, then (2) Br_2, $FeBr_3$

99.



In the above compound Cl will liberated easily in the form of :

(a) $Cl^{\oplus}$ (b) Cl^{-} (c) $Cl^{\bullet}$ (d) Cl^{2+}

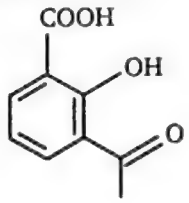
100. Consider the following sequence of reactions:

$PhCO_2H \xrightarrow[2.NH_3]{1.\ PCl_5} A \xrightarrow[2.H_2/Ni]{1.\ P_4O_{10},\ heat} B$. The final product (*B*) is :

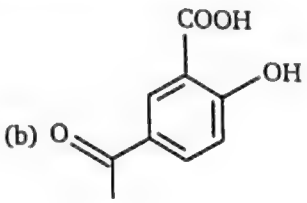
(a) benzonitrile (b) benzylamine (c) aniline (d) benzamide

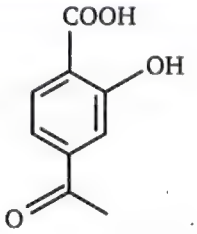
101. The major product of the acetylation of salicylic acid with Ac_2O/H^+ followed by heating with anhydrous $AlCl_3$ is :

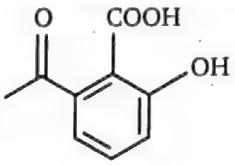
(a)



(b)



(c) 

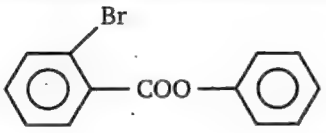
(d) 

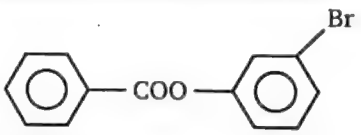
102. Which one of the following statements is **True:**

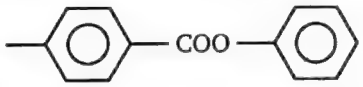
1 2

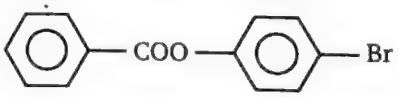
(a) PhLi adds to both compounds with equal ease
(b) PhLi does not add to either of the compounds
(c) PhLi reacts readily with 1 but does not add to 2
(d) PhLi reacts readily with 2 but does not add to 1

103. The major product expected from the mono-bromination of phenyl benzoate is :

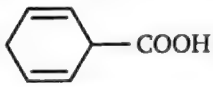
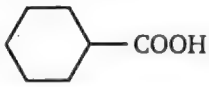
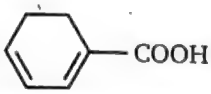
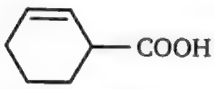
(a) 

(b) 

(c) 

(d) 

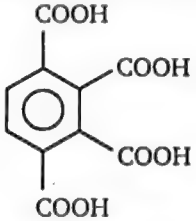
104. The Birch reduction of benzoic acid gives :

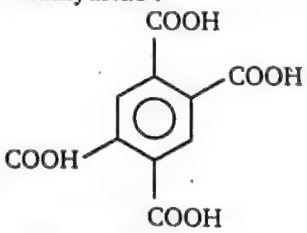
(a)  (b)  (c)  (d) 

105. The decreasing order of reactivity of meta-nitrobromobenzene (I), 2,4,6-trinitrobromobenzene (II), para-nitrobromobenzene (III), and 2,4-dinitrobromobenzene (IV) towards HO^- ions is :

(a) I > II > III > IV (b) II > IV > III > I (c) IV > II > III > I (d) II > IV > I > III

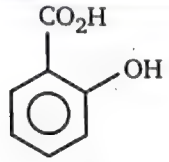
106. Which of the following tetracarboxylic acid form di-anhydride :

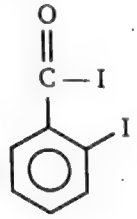
(a) 

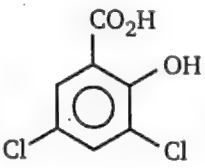
(b) 

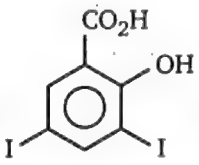
(c) neither (a) nor (b)

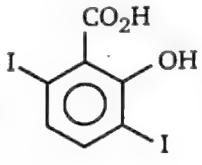
(d) both (a) and (b)

107.  $\xrightarrow{2I-Cl}$ (*A*); unknown (*A*) is :

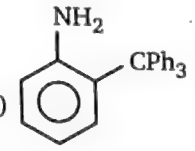
(a) 

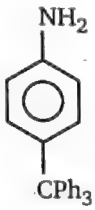
(b) 

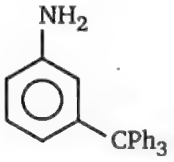
(c) 

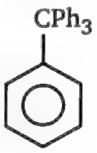
(d) 

108. $Ph-NH_2 + Ph_3COH \xrightarrow{H^+/D} \underset{\text{(major)}}{P}$ (not a N-derivative), Product (*P*) is :

(a) 

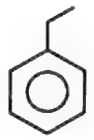
(b) 

(c) 

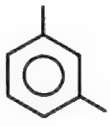
(d) 

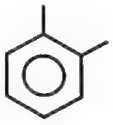
109. Deduce structure of (*A*).

(*A*) $C_8H_{10} \xrightarrow{KMnO_4}$ (*B*) $C_8H_6O_4 \xrightarrow[Fe]{Br_2} C_8H_5BrO_4$ (*C*) (one-product only) :

(a) 

(b) 

(c) 

(d) 

110. The deamination of $Ph_2C(OH)CH_2NH_2$ with $NaNO_2 - HCl$ gives a product (*P*), which on oxidation gives benzoic acid only. Identify the product (*P*).

(a) $Ph-CH_2-CH_2-Ph$

(b) 

(c) 

(d) $Ph-CH_2-NH-Ph$

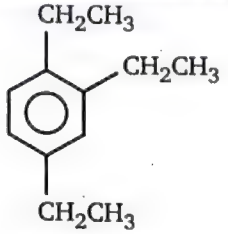
111. $Ph-CO_2H \xrightarrow{SOCl_2} A \xrightarrow{Me_2NH} B \xrightarrow{(C)} Ph-CHO$, unknown reagent (*C*) is :

(a) $LiAlH_4$

(b) $NaBH_4$

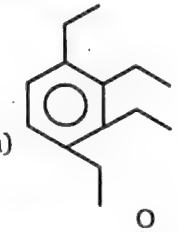
(c) $LiAlH_4(t\text{-}BuO)_3$

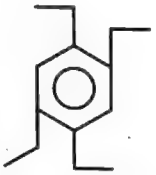
(d) PCC/CH_2Cl_2

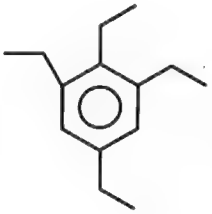
112. 

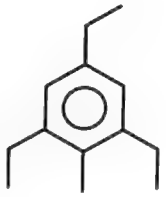
$\xrightarrow[AlCl_3]{CH_3-\overset{O}{\overset{\|}{C}}-Cl}$ (*A*) (80%) $\xrightarrow[\text{triethylene glycol. heat}]{NH_2-NH_2,\ NaOH}$ (*B*) (73%)

Product (*B*) is :

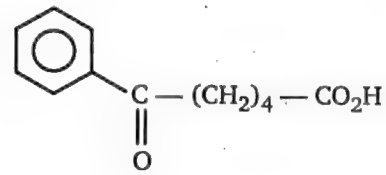
(a) 

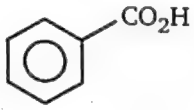
(b) 

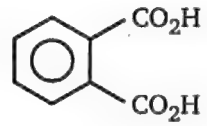
(c) 

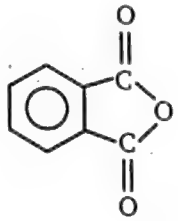
(d) 

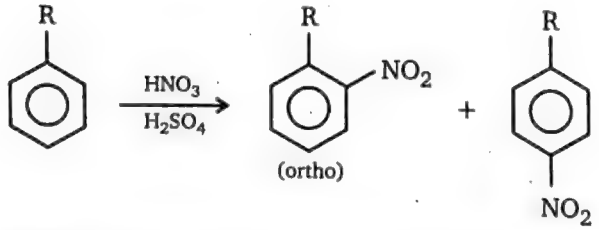
113. $C_6H_5(CH_2)_5\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[CS_2]{AlCl_3} \underset{C_{12}H_{14}O}{(A)} \xrightarrow[H_3O^{\oplus}]{KMnO_4,\ D} (B)$; Compound (*B*) is :

(a) 

(b) 

(c) 

(d) 

114. 

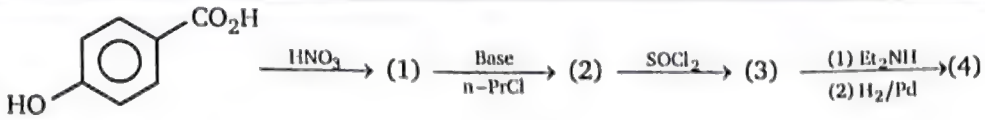
In the above reaction *o/p* ratio will be highest when :

(a) R = – CH_3

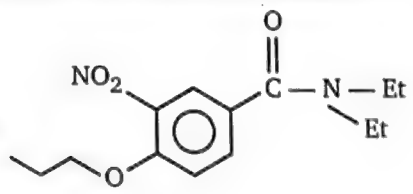
(b) R = – CH_2-CH_3

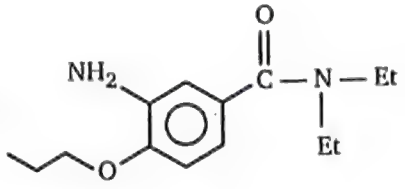
(c) R = – $CHMe_2$

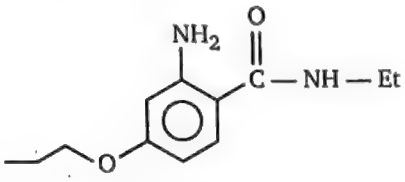
(d) R = – CMe_3

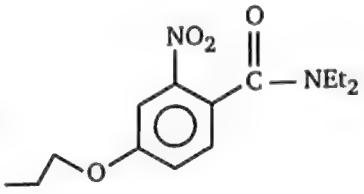
115. 

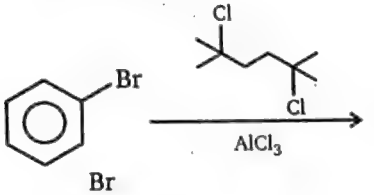
product (4) in the above reaction is :

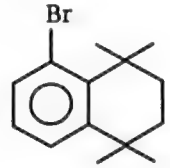
(a) 

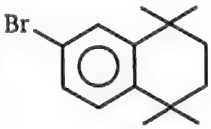
(b) 

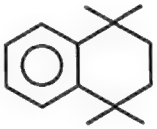
(c) 

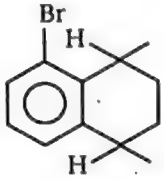
(d) 

116.  (*A*); Product (*A*) of the reaction is :

(a) 

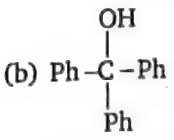
(b) 

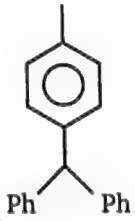
(c) 

(d) 

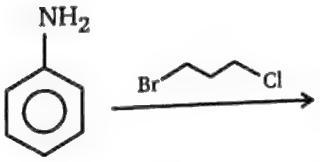
117. Ph – CHO + 2  $\xrightarrow{H_2SO_4}$ major product of this reaction is :

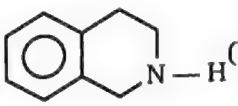
(a) Ph_3CH

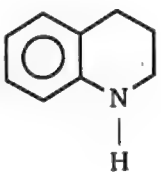
(b) 

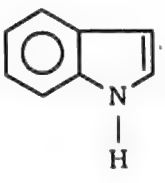
(c) 

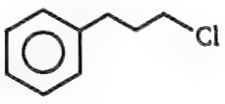
(d) Ph_2CH_2

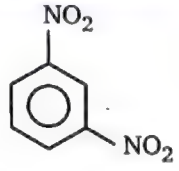
118.  (*A*); Product (*A*) of this reaction is :

(a) 

(b) 

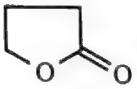
(c) 

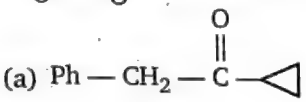
(d) 

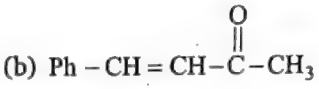
119.  $\xrightarrow[\text{five days to complete}]{HNO_3+H_2SO_4}$ (*X*); Compound (*X*) is :

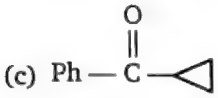
(a) 1,2,4-Trinitrobenzene (b) 1,3,5-Trinitrobenzene

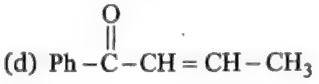
(c) 1,2,3 -Trinitrobenzene (d) Tri-nitro toluene (TNT)

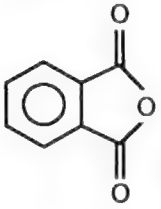
120.  $\xrightarrow[(ii)\ SOCl_2]{(i)\ HCl}$ (*A*) $\xrightarrow[AlCl_3]{Ph-H}$ (*B*) $\xrightarrow{KOH/MeOH}$ (*C*); Compound (*C*) is :

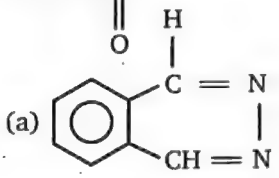
(a) 

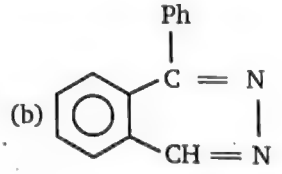
(b) 

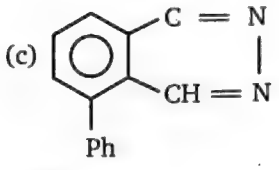
(c) 

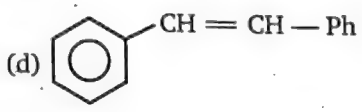
(d) 

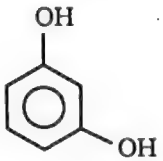
121.  $\xrightarrow[AlCl_3]{C_6H_6}$ (*A*) $\xrightarrow[(ii)\ H_2/Pd-BaSO_4]{(i)\ PCl_5}$ (*B*) $\xrightarrow{NH_2-NH_2}$ (*C*); Compound (*C*) is :

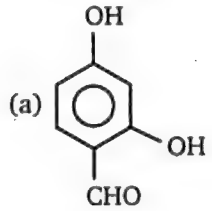
(a) 

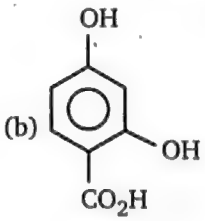
(b) 

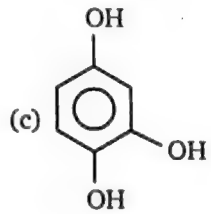
(c) 

(d) 

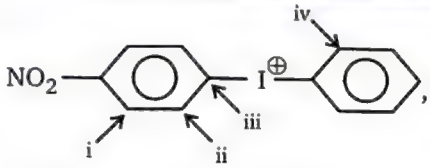
122.  $\xrightarrow[H_3O^+]{(i)\ aq\ NaHCO_3/boil}$ (*A*) (major), Product (*A*) in this reaction is :

(a) 

(b) 

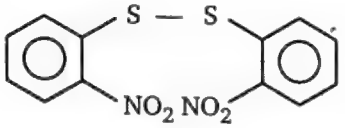
(c) 

(d) No reaction

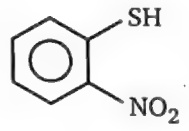
123. 

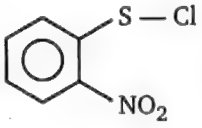
, Identify position where attack of (ArO^-) is favourable.

(a) i (b) ii (c) iii (d) iv

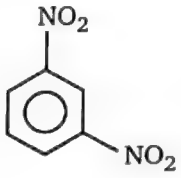
124. 

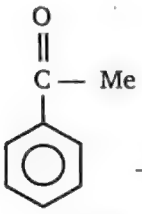
$\xrightarrow{Cl_2}$ (*A*), Product (*A*) of this reaction is :

(a) 

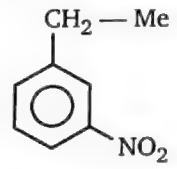
(b) 

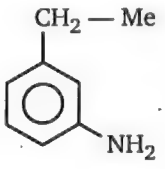
(c) 

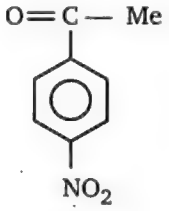
(d) 

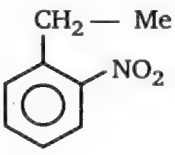
125. 

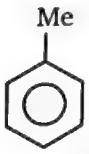
$\xrightarrow[H_2SO_4]{HNO_3}$ (*A*) $\xrightarrow[HCl]{Zn(Hg)}$ (*B*), Product (*B*) of this reaction is :

(a) 

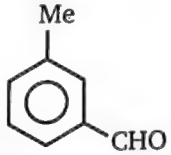
(b) 

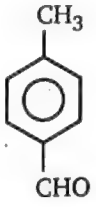
(c) 

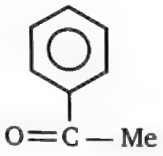
(d) 

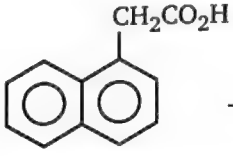
126. 

+HN = CH – Cl $\xrightarrow{AlCl_3}$ (*A*) $\xrightarrow{H_3O^+}$ (*B*), Product (*B*) of this reaction is :

(a) 

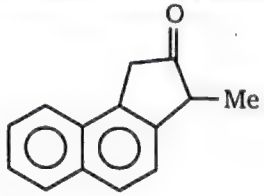
(b) 

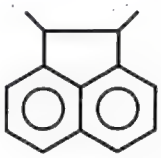
(c) No-reaction (d) 

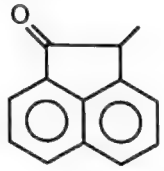
127. 

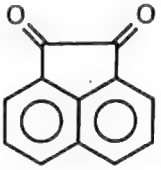
$\xrightarrow[H^+]{EtOH}$ $\xrightarrow[(ii)\ MeI]{(i)\ NaH}$ $\xrightarrow[(ii)\ H^+]{(i)\ NaOH}$ $\xrightarrow[(ii)\ AlCl_3]{(i)\ SOCl_2}$; Product

End product of the above reaction is :

(a) 

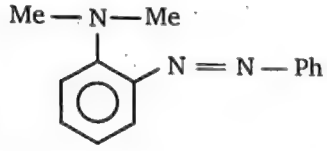
(b) 

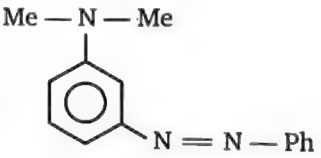
(c) 

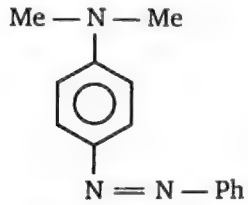
(d) 

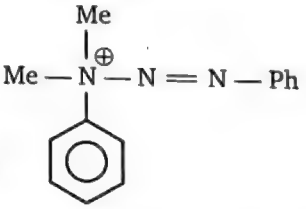
128. $Ph-NH_2 \xrightarrow{CH_3-Cl\ (2mole)} (A) \xrightarrow{Ph-\overset{\oplus}{N_2}\ \overset{-}{Cl}} \underset{\text{Butter yellow}}{(B)}$ (major)

Product of the above reaction is :

(a) 

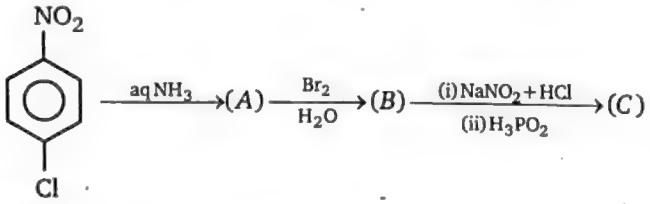
(b) 

(c) 

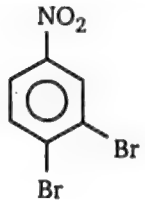
(d) 

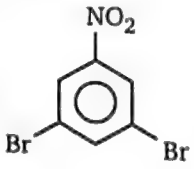
129. *p*-Toluedine reacts with benzene diazonium chloride to form compound, which on boiling with aq. H_2SO_4 give ..... products :

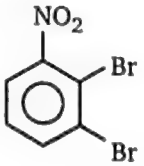
(a) 3 (b) 2 (c) 4 (d) 5

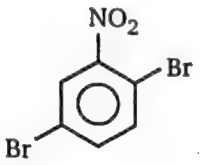
130. 

Product (*C*) of the above reaction is :

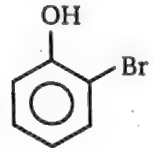
(a) 

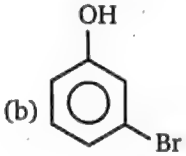
(b) 

(c) 

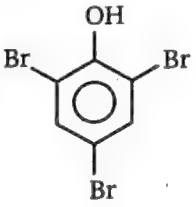
(d) 

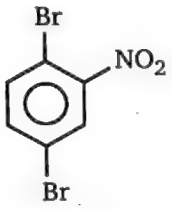
131.  $\xrightarrow[\underset{\text{(Fenton's reagent)}}{H_2O_2}]{Fe^{+2}}$ (A) $\xrightarrow[H_2O]{Br_2}$ (B) $_{(= 100\%)}$; Major product (B) of this reaction is :

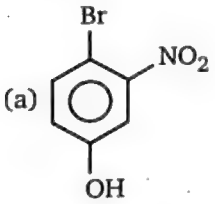
(a) 

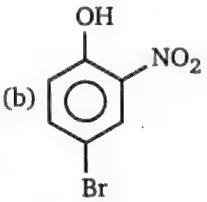
(b) 

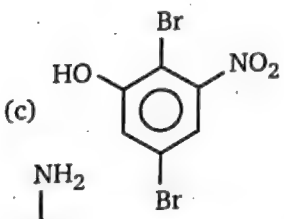
(c) 

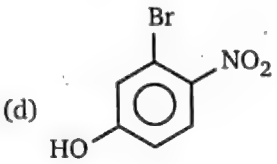
(d) 

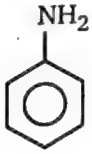
132.  $\xrightarrow{HO^-}$ (A) ; Product of the given reaction is :

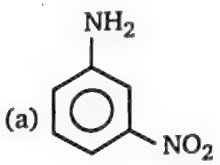
(a) 

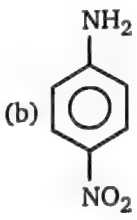
(b) 

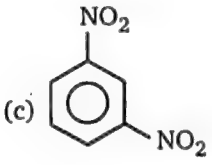
(c) 

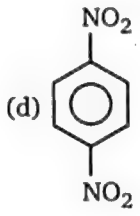
(d) 

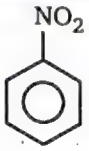
133.  $\xrightarrow{(CH_3CO)_2O}$ (A) $\xrightarrow[H_2SO_4]{HNO_3}$ (B) $\xrightarrow[H_2O]{H^+}$ (C), Product (C) of this reaction is :

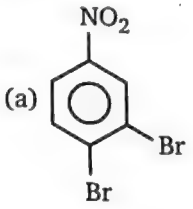
(a) 

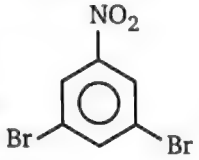
(b) 

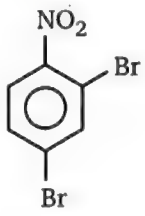
(c) 

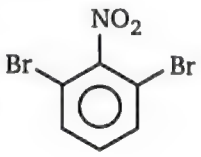
(d) 

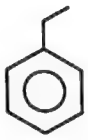
134.  $\xrightarrow[Fe]{Br_2\,(2mole)}$ (*A*) (major) ; Product (*A*) will be :

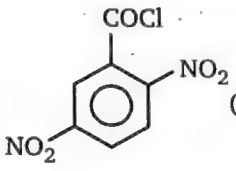
(a) 

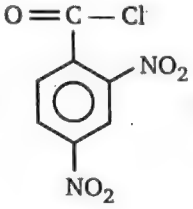
(b) 

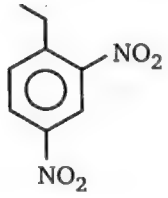
(c) 

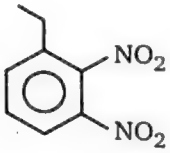
(d) 

135.  $\xrightarrow[(ii)\ H_2SO_4]{(i)\ HNO_3}$ (*A*) (Di- nitro product) $\xrightarrow{KMnO_4/\Delta}$ (*B*) $\xrightarrow{SOCl_2}$ (*C*); Product (*C*) of this reaction is :

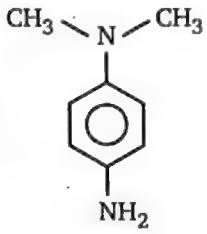
(a) 

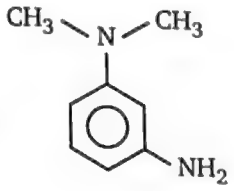
(b) 

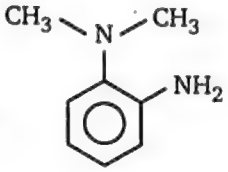
(c) 

(d) 

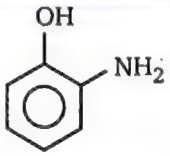
136.  $\xrightarrow{CH_3-NH-CH_3}$ (*A*) $\xrightarrow[HCl]{Fe}$ (*B*) ; Product (*B*) of this reaction is :

(a) 

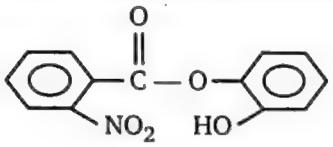
(b) 

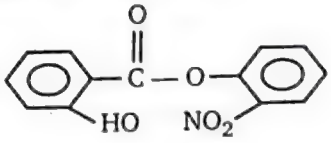
(c) 

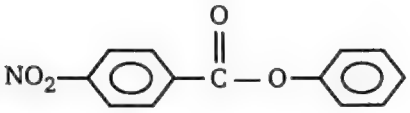
(d) None of these

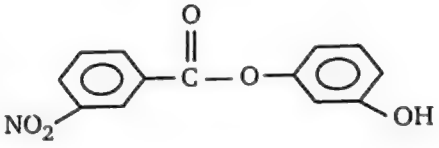
137. $(A) \xrightarrow[(ii)\,NH_3]{(i)\,SOCl_2} (B) \xrightarrow{Br_2 + KOH}$ 

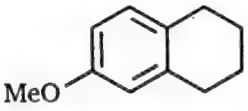
Which of the following compound on hydrolysis gives reactant (*A*) :

(a) 

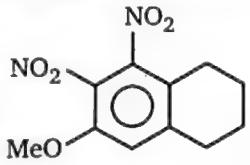
(b) 

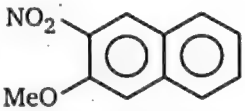
(c) 

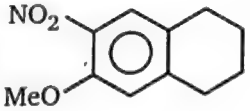
(d) 

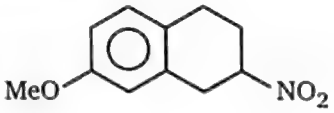
138.  $\xrightarrow{HNO_3/H_2SO_4}$ (*A*);

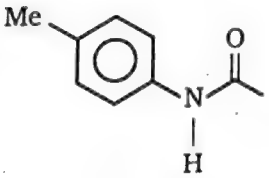
Product (*A*) of the above reaction is :

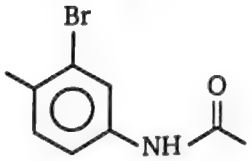
(a) 

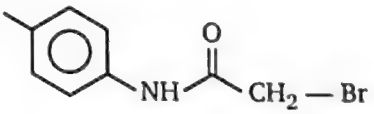
(b) 

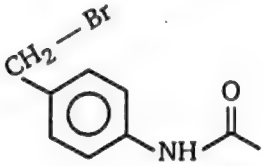
(c) 

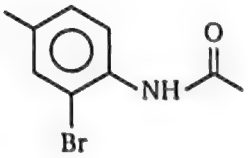
(d) 

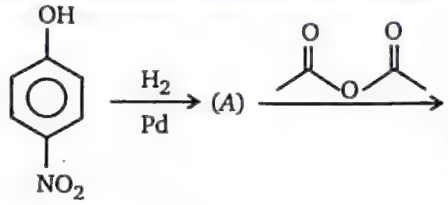
139.  $\xrightarrow[CS_2]{Br_2}$; Product of the reaction is :

(a) 

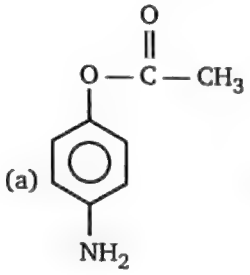
(b) 

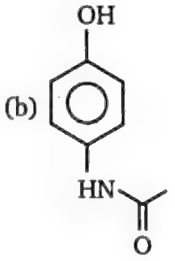
(c) 

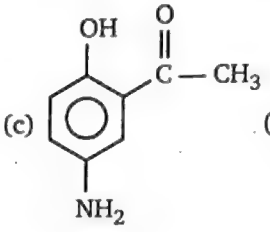
(d) 

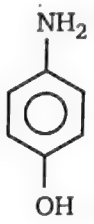
140. 

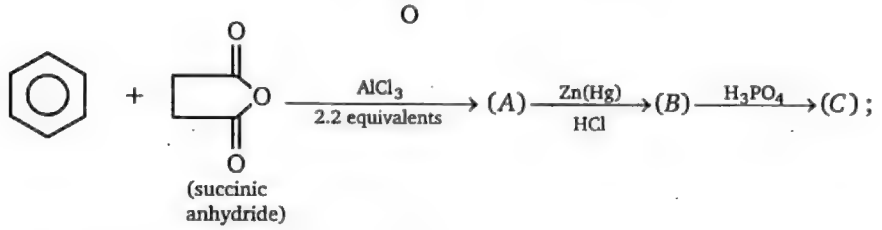
; Product (*B*) of this reaction is :

(a) 

(b) 

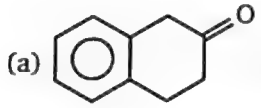
(c) 

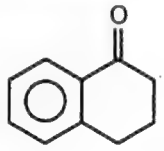
(d) 

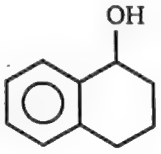
141. 

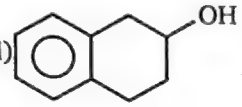
;

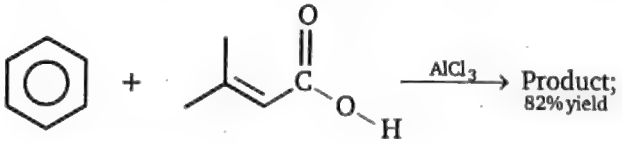
Product (*C*) of the above reaction is :

(a) 

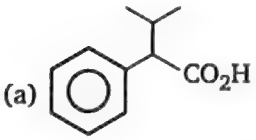
(b) 

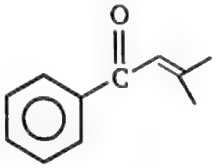
(c) 

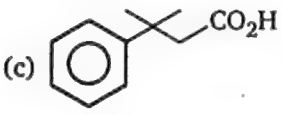
(d) 

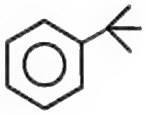
142. 

Product of the above Friedel-Craft reaction is :

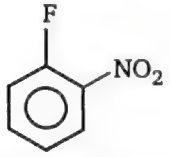
(a) 

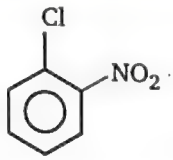
(b) 

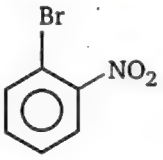
(c) 

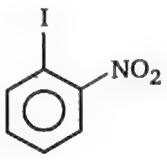
(d) 

143. Which of the following 2-halo nitrobenzene is most reactive towards nucleophilic aromatic substitution ?

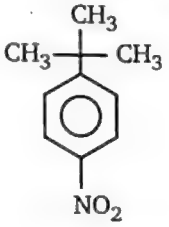
(a) 

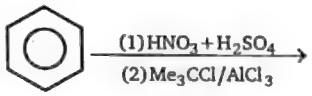
(b) 

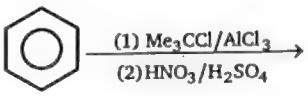
(c) 

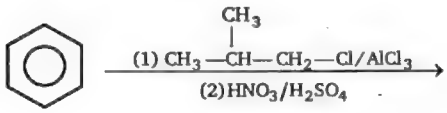
(d) 

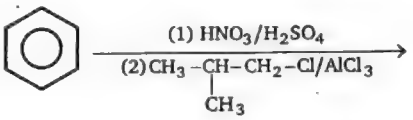
144. Choose the best method to prepare given compound :

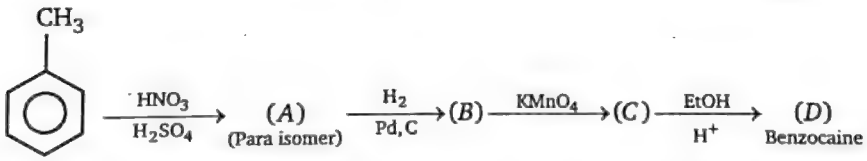


(a) 

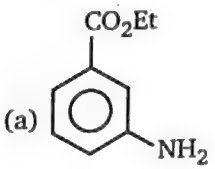
(b) 

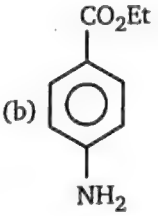
(c) 

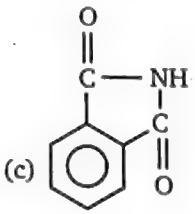
(d) 

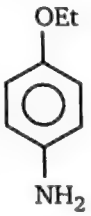
145. 

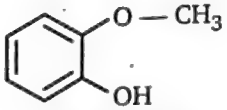
Benzocaine has been used as a component of appetite suppressants, burn and sunburn remedies. Benzocaine is :

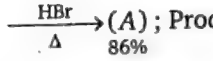
(a) 

(b) 

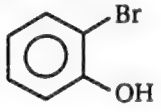
(c) 

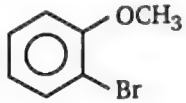
(d) 

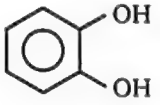
146. 

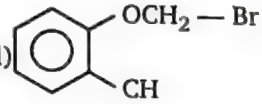


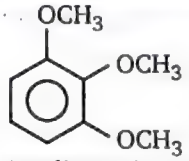
; Product (A) of this reaction is :

(a) 

(b) 

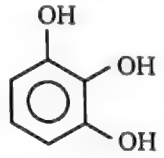
(c) 

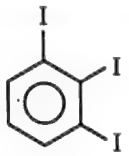
(d) 

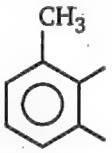
147. 

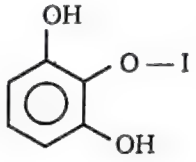
$\xrightarrow[\Delta]{HI\,(excess)}$ Product.

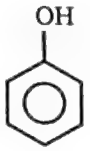
Predict major product of the above reaction is :

(a) 

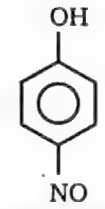
(b) 

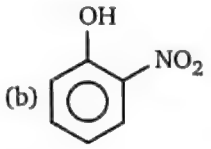
(c) 

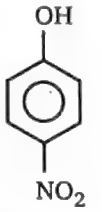
(d) 

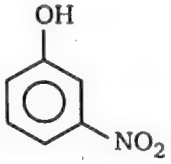
148. 

$\xrightarrow[HNO_3]{HNO_2}$ (A) (Major) ; Product (A) is :

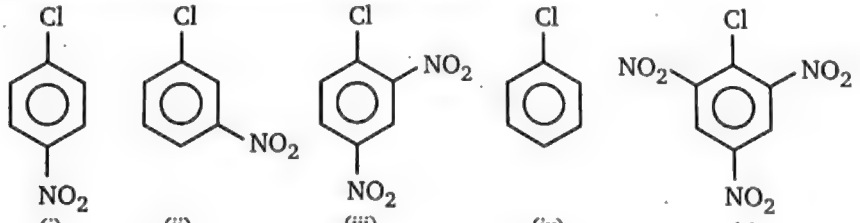
(a) 

(b) 

(c) 

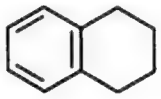
(d) 

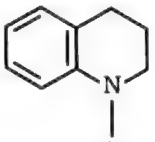
149. Arrange in their decreasing order of rate in SNAr.

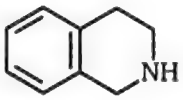


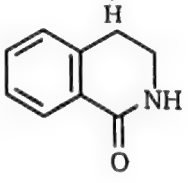
(a) i > ii > iv > iii > v
(b) ii > i > iii > v > iv
(c) v > iii > i > ii > iv
(d) v > iii > ii > i > iv

150. Which one of the following compounds undergoes bromination of its aromatic ring (electrophilic aromatic substitution) at the fastest rate ?

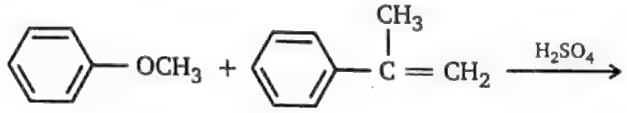
(a) 

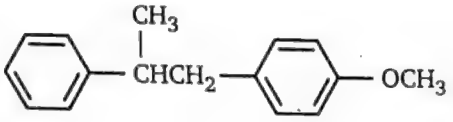
(b) 

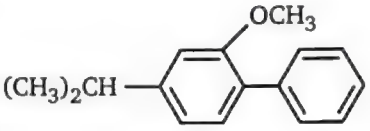
(c) 

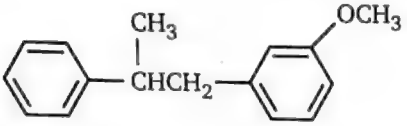
(d) 

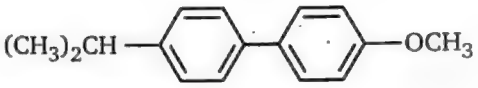
151. What is the product of the following reaction ?



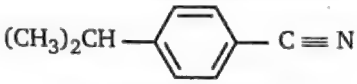
(a) 

(b) 

(c) 

(d) 

152. Which sequence represents the best synthesis of 4-isopropylbenzonitrile ?



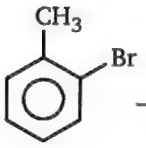
4-Isopropylbenzonitrile

(a) **1.** Benzene + $(CH_3)_2CHCl, AlCl_3$; **2.** $Br_2, FeBr_3$; **3.** KCN

(b) **1.** Benzene + $(CH_3)_2CHCl, AlCl_3$; **2.** HNO_3, H_2SO_4; **3.** Fe, HCl,; **4.** NaOH **5.** $NaNO_2$, HCl, H_2O

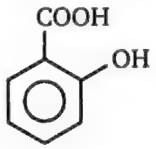
(c) **1.** Benzene +$(CH_3)_2CHCl, AlCl_3$; **2.** HNO_3, H_2SO_4 ; **3.** Fe, HCl ; **4.** $NaNO_2$/HCl **5.** KCN

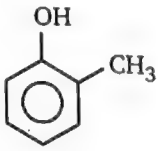
(d) **1.** Benzene + HNO_3, H_2SO_4 ; **2.** $(CH_3)_2CHCl, AlCl_3$; **3.** Fe, HCl; **4.** $NaNO_2, HCl, H_2O$; **5.** CuCN

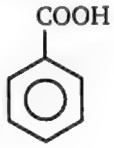
153. 

1. Mg/Ether
2. H_3O^+
3. $KMnO_4/OH^-$
4. H^+

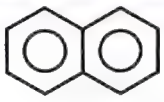
→ *A*, Product *A* is :

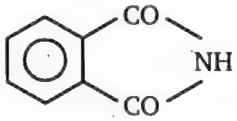
(a) 

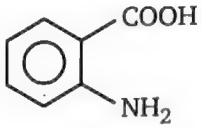
(b) 

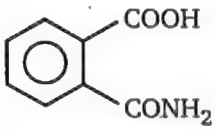
(c) 

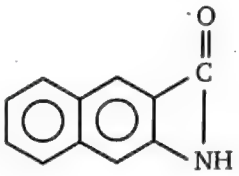
(d) 

154.  $\xrightarrow[2.\ NH_3,\Delta]{1.\ Air,V_2O_5,\Delta}$ A, Product A is :

(a) 

(b) 

(c) 

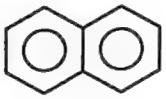
(d) 

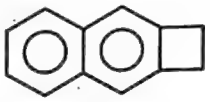
155. What is correct order of rate of nitration of the following compounds ?

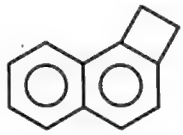
$\underset{A}{C_6H_5CH_3}$ $\underset{B}{C_6H_6}$ $\underset{C}{C_6D_6}$ $\underset{D}{C_6T_6}$ $\underset{E}{C_6H_5Br_3}$ $\underset{F}{C_6H_5\overset{+}{N}R_3}$ $\underset{G}{C_6H_5NMe_2}$

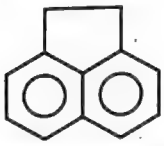
(a) G > A > B > C > D > E > F (b) G > B > C > D > A > F

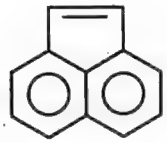
(c) G > A > B = C = D > E > F (d) G > A > B > C = D > E > F

156.  $+$  $\xrightarrow{AlCl_3}[X]\xrightarrow[\text{excess}]{Na-Hg,HCl}[Y]$; Product Y is :

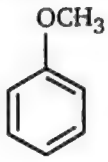
(a) 

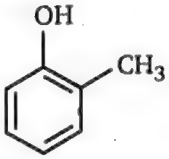
(b) 

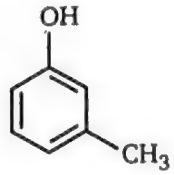
(c) 

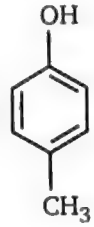
(d) 

157. Compound A (C_7H_8O) is insoluble in water, dilute HCl & aqueous $NaHCO_3$, but it dissolves in dilute NaOH. When A is treated with Br_2 water it is converted into a compound $C_7H_5OBr_3$ rapidly. The structure of A is :

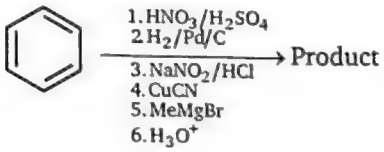
(a) 

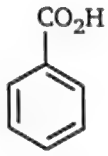
(b) 

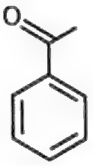
(c) 

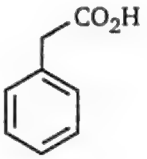
(d) 

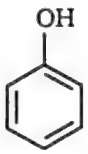
158. Give the product of the following reaction sequence :



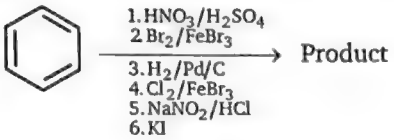
(a) 

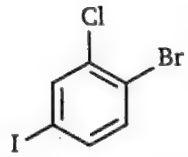
(b) 

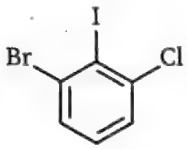
(c) 

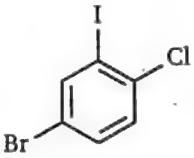
(d) 

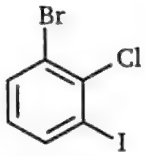
159. Give the product of the following reaction sequence:



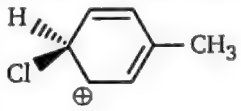
(a) 

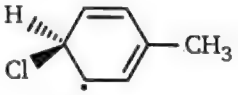
(b) 

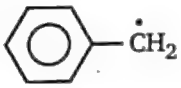
(c) 

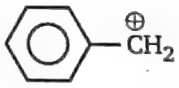
(d) 

160. Which represents an intermediate formed in the reaction of toluene and chlorine at elevated temperature in sunlight ?

(a) 

(b) 

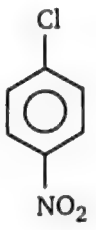
(c) 

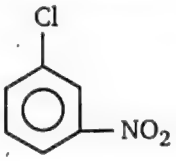
(d) 

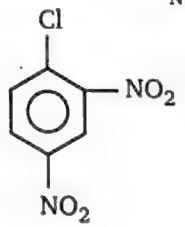
161. The decreasing order of reactivity of *m*-nitrobromobenzene (I), 2, 4, 6- trinitrobromo-benzene (II), *p*-nitrobromobenzene (III), and 2,4-dinitrobromobenzene (IV), towards OH^- ions is :

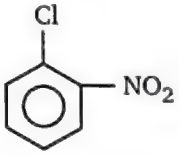
(a) I > II > III > IV
(b) II > IV > III > I
(c) IV > II > III > I
(d) II > IV > I > III

162. Which one of the following compounds is most reactive for ArS_{N^2} reaction ?

(a) 

(b) 

(c) 

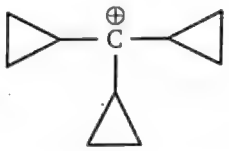
(d) 

163. Which one amongst the following carbocations is most stable ?

(a) $C_6H_5-\overset{\oplus}{C}H-C_6H_5$

(b) 

(c) $CH_3-\overset{\oplus}{C}(CH_3)-CH_3$ (with CH_3 below)

(d) 

164. Cyclopentadiene is much more acidic than cyclopentane. The reason is that :

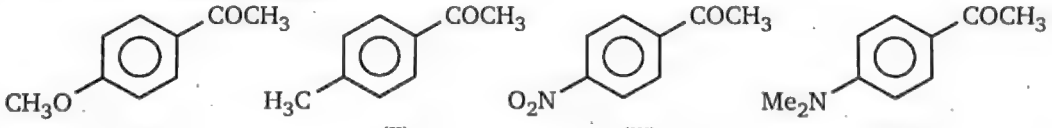
(a) cyclopentadiene has conjugated double bonds

(b) cyclopentadiene has both sp^2 and sp^3 hybridized carbon atoms

(c) cyclopentadiene is a strain-free cyclic system

(d) cyclopentadienide ion, the conjugate base of cyclopentadiene, is an aromatic species and hence has higher stability

165.



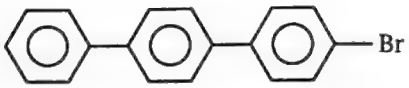
(I) (II) (III) (IV)

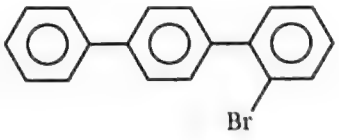
Friedel-Crafts acylation reaction can be used to obtain the compounds

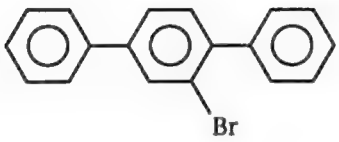
(a) II, III and IV (b) I, III and IV

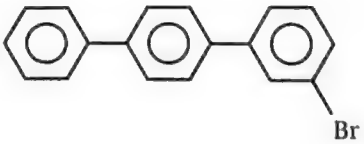
(c) I and II (d) II and III

166. The major product of the reaction is :

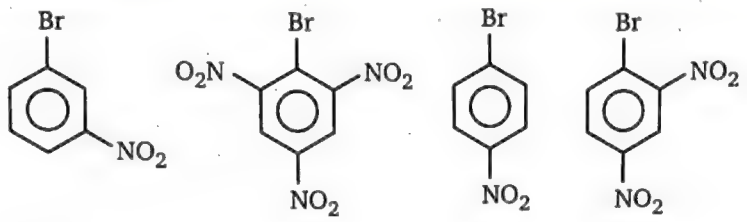
(a) 

(b) 

(c) 

(d) 

167. The decreasing order of reactivity of given compound towards nucleophilic substitution with aqueous NaOH is :

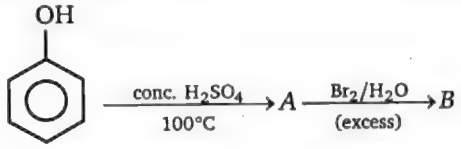


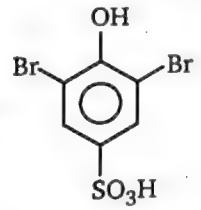
(I) (II) (III) (IV)

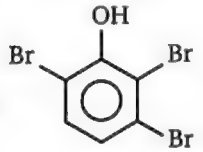
(a) I > II > III > IV (b) II > IV > III > I

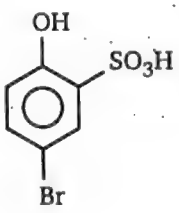
(c) IV > II > III > I (d) II > IV > I > III

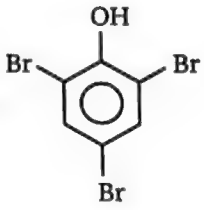
168. Identify the end product (*B*) of the following sequence of reactions.



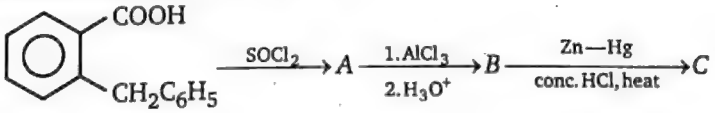
(a) 

(b) 

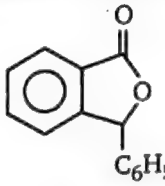
(c) 

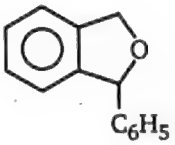
(d) 

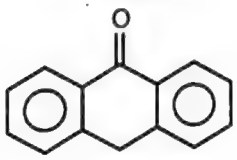
169. Consider the following sequence of reactions :

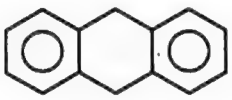


The end product (*C*) is :

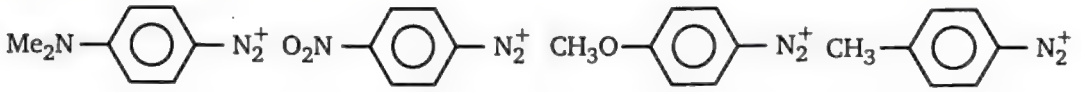
(a) 

(b) 

(c) 

(d) 

170. For the diazonium ions the order of reactivity towards diazo-coupling with phenol in the presence of dilute NaOH is :

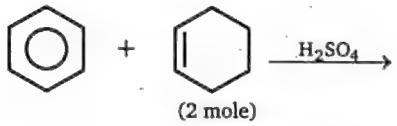


(I) (II) (III) (IV)

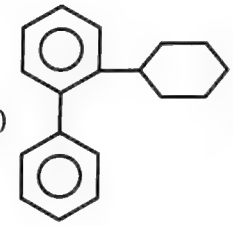
(a) I < IV < II < III (b) I < III < IV < II

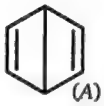
(c) III < I < II < IV (d) III < I < IV < II

171. Major product obtained in given reaction is :



(2 mole)

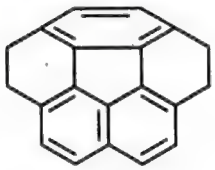
(a)  (b)  (c)  (d) 

172.  (A) $\xrightarrow[\text{or } AlCl_3]{H^{\oplus}}$ (major) (B) ; (A) & (B) are isomers. Product (B) is :

Dewar's Benzene

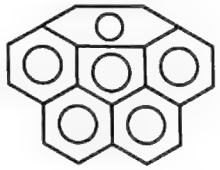
(a)  (b)  (c)  (d) 

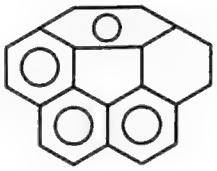
173. The step shown below is a recent synthesis of corannulene.

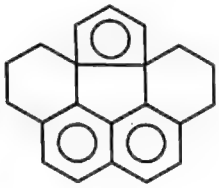


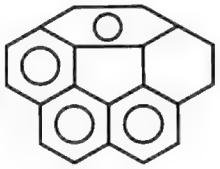
$\xrightarrow[(\Delta)]{Pd/C}$ (A) $C_{20}H_{10}$ Corannulene

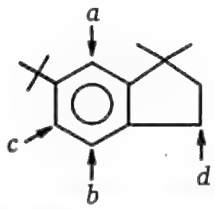
Product (A) is :

(a) 

(b) 

(c) 

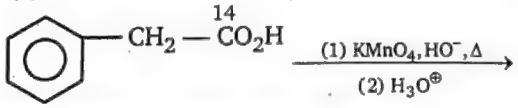
(d) 

174. 

Identify the position where E.A.S. will take place :

(a) *a* (b) *b*

(c) *c* (d) all the position are identical

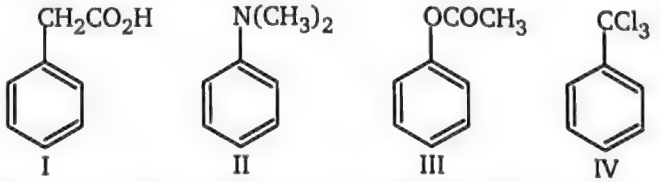
175. 

The labelled carbon goes with :

(a) Ph — $\overset{14}{C}O_2H$ (b) $\overset{14}{C}O_2$ (c) Ph — $\overset{14}{C}H_2$ — CO_2H (d) $\overset{14}{C}H_4$

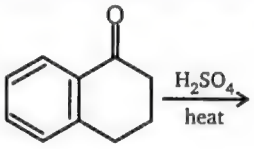
176. What is the expected order of reactivity of the following compounds in electrophilic chlorination ($Cl_2 + FeCl_3$) ?

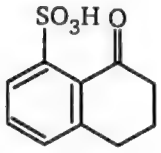
(more reactive > less reactive)

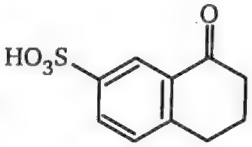


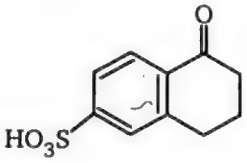
(a) I > II > III > IV (b) IV > III > II > I (c) III > I > IV > II (d) II > III > I > IV

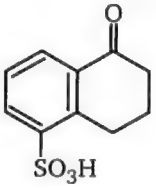
177. Which of the following is the major product from sulfonation of α-tetralone ?



(a) 

(b) 

(c) 

(d) 

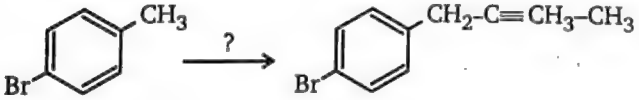
178. Which of the following procedures would be best for the preparation of phenyl benzyl ether ?

$C_6H_5OCH_2C_6H_5$

(a) $C_6H_5Cl + C_6H_5CH_2O^{(-)}Na^{(+)}$ (b) $C_6H_5O^{(-)}Na^{(+)} + C_6H_5CH_2Cl$

(c) $2C_6H_5Cl + Na_2O$ (d) $2C_6H_5MgBr + CH_2O$

179. Which of the following procedures would be best for achieving the following reaction ?



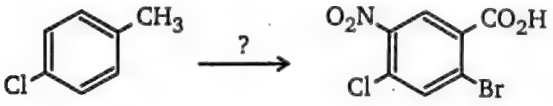
(a) (i) KOH and heat (ii) $CH_3C \equiv C - Br$

(b) (i) $KMnO_4$ and heat (ii) $CH_3C \equiv C^{(-)}Na^{(+)}$ (iii) excess H_2O

(c) (i) NBS in CCl_4 and heat (ii) $CH_3C \equiv C^{(-)}Na^{(+)}$

(d) (i) Mg in ether (ii) $CH_3C \equiv CBr$ (iii) excess H_3PO_4

180. Which of the following procedures would be best for achieving the following reaction ?



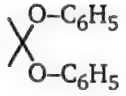
(a) (i) $Br_2 + FeBr_3$ (ii) $KMnO_4$ and heat (iii) HNO_3 and H_2SO_4

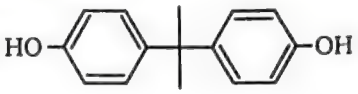
(b) (i) $KMnO_4$ and heat (ii) $Br_2 + FeBr_3$ (iii) HNO_3 and H_2SO_4

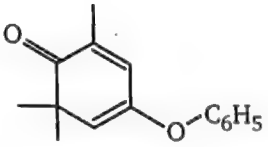
(c) (i) NBS in CCl_4 and heat (ii) $KMnO_4$ and heat (iii) HNO_3 and H_2SO_4

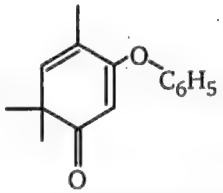
(d) (i) NBS in CCl_4 and heat (ii) $NaNO_2$ and heat

181. Phenol reacts with acetone in the presence of conc. sulphuric acid to form a $C_{15}H_{16}O_2$ product. Which of the following compounds is this product ?

(a) 

(b) 

(c) 

(d) 

182. Heating benzene in a large excess of 80% D_2SO_4 in D_2O results in what product ?

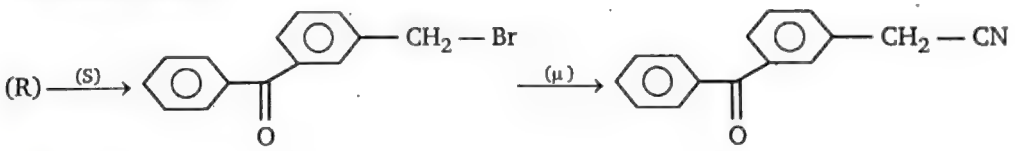
(a) $C_6H_5SO_3D$ (b) C_6H_5OD (c) C_6H_5D (d) C_6D_6

183. A solution of cyclohexene in benzene is stirred at 0°C while concentrated sulphuric acid is added. After washing away the acid and removing the excess benzene, what product is isolated?

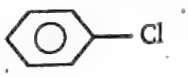
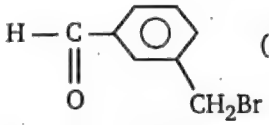
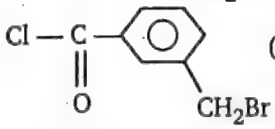
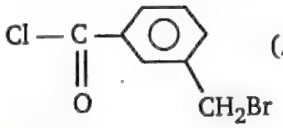
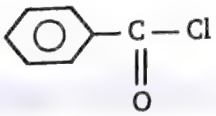
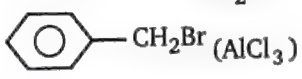
(a) cyclohexylbenzene (b) 1-cyclohexylcyclohexene

(c) *trans*-1,2-diphenylcyclohexane (d) 1,1-diphenylcyclohexane

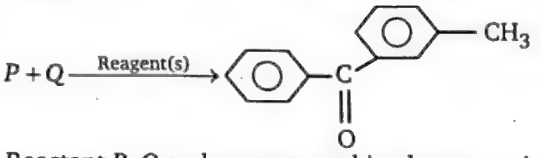
184. Indentify the reagents S and μ in the scheme below in which R is converted to the nitrite V via the benzylic halide T.



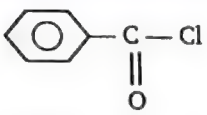
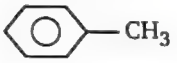
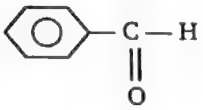
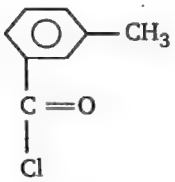
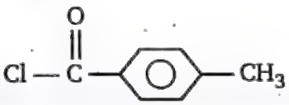
R, S and μ respectively are :

	R	S	μ
(a)		 $(AlCl_3)$	HCN
(b)		 $(AlCl_3)$	HCN
(c)		 $(AlCl_3)$	KCN
(d)		 $(AlCl_3)$	KCN

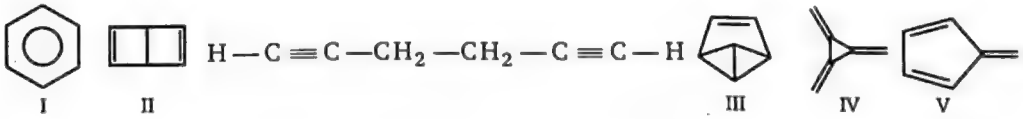
185. Two aromatic compounds *P* and *Q* give product *R*.



Reactant *P*, *Q* and reagent used in above reaction are :

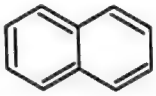
	P	Q	Reagent
(a)			$AlCl_3$
(b)			$AlCl_3$
(c)			$AlCl_3$
(d)			$ZnCl_2$

186. Which of the following C_6H_6 compounds has a single set of structurally equivalent hydrogen atoms ?



(a) I and II (b) I and IV (c) I and V (d) I, II and III

187. Which of the following compounds would not be considered aromatic in its behaviour?

(a)  (b)  (c)  (d) 

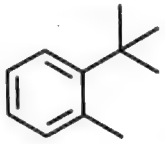
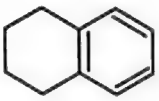
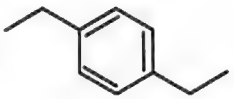
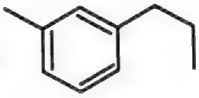
188. A C_8H_{10} hydrocarbon is nitrated by HNO_3 and sulphuric acid. Two, and only two, $C_8H_9NO_2$ isomers are obtained. Which of the following fits this evidence ?

(a) ethyl benzene (b) *ortho*-xylene (c) *meta*-xylene (d) *para*-xylene

189. Which of the following benzene ring substituents is deactivating but *ortho-para* directing ?

(a) $-N=O$ (b) $-OCH_3$ (c) $-COCH_3$ (d) $-NO_2$

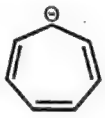
190. Which of the following compounds forms *ortho*- benzenedicarboxylic acid when oxidized by hot aqueous potassium permanganate ?

(a)  (b)  (c)  (d) 

191. Which of the following organic chlorides will not give a Friedel-Craft alkylation product when heated with benzene and $AlCl_3$?

(a) $(CH_3)_3CCl$ (b) $CH_2=CHCH_2Cl$ (c) CH_3CH_2Cl (d) $CH_2=CHCl$

192. Which of the following is aromatic ?

(a)  (b)  (carbene) (c)  (d)  (carbene)

193. Which of the following substance will increase the acidity of phenol ?

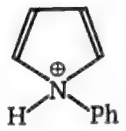
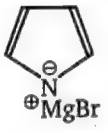
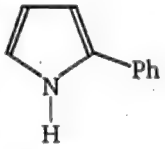
(a) Dil. H_2SO_4 (b) Dil. HCl (c) Conc. H_2SO_4 (d) Conc. CH_3COOH

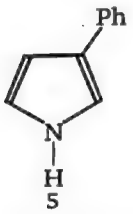
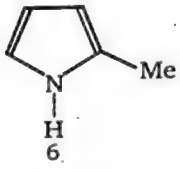
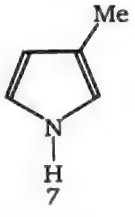
194.  + PhMgBr $\longrightarrow E + F$

Pyrrole

E + MeCl $\longrightarrow G + H$

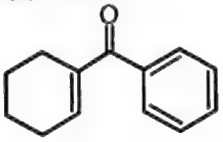
F + MeCl $\longrightarrow$ no reaction without a catalyst

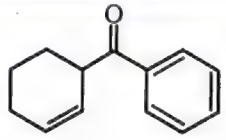
 1  2  3  4

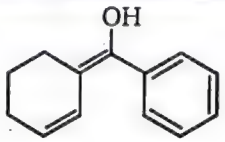
 5  6  7

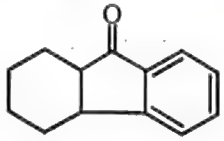
The structure of products $E - H$, respectively are

(a) 3, 2, 6, 7 (b) 4, 5, 6, 1 (c) 3, 4, 5, 2 (d) 3, 2, 4, 5

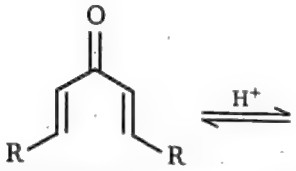
195.  $\xrightarrow{H^+}$ (A); Product A is :

(a) 

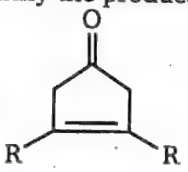
(b) 

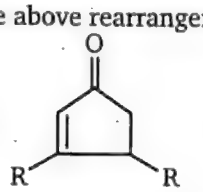
(c) 

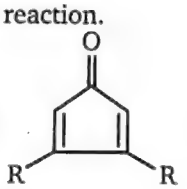
(d) none of these

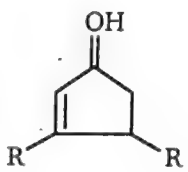
196. 

Identify the product of the above rearrangement reaction.

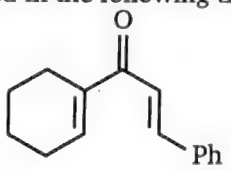
(a) 

(b) 

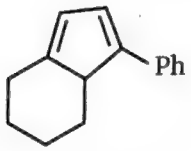
(c) 

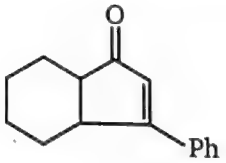
(d) 

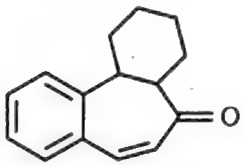
197. Product obtained in the following transformation is :

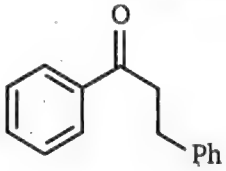


PPA = polyphosphoric acid

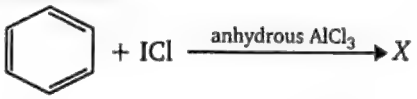
(a) 

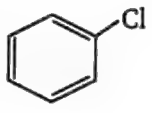
(b) 

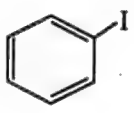
(c) 

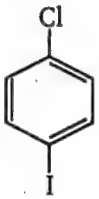
(d) 

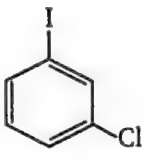
198. The compound *X* in the reaction.

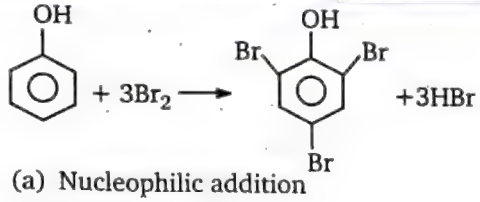


(a) 

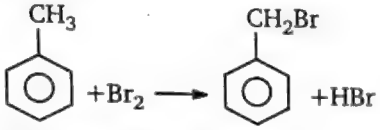
(b) 

(c) 

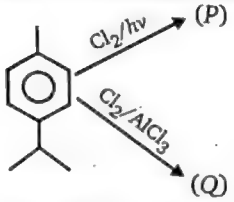
(d) 

199. 

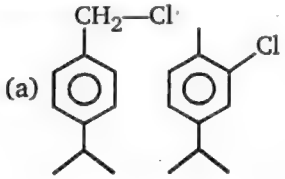
(a) Nucleophilic addition
(b) Nucleophilic substitution
(c) Electrophilic addition
(d) Electrophilic substitution
(e) Free radical substitution

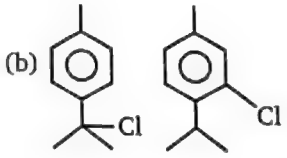
200. 

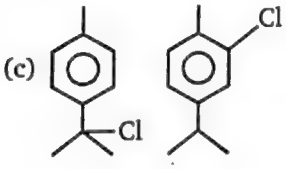
(a) Nucleophilic addition
(b) Nucleophilic substitution
(c) Electrophilic addition
(d) Electrophilic substitution
(e) Free radical substitution

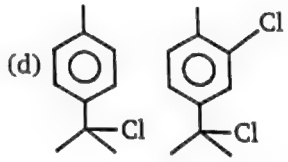
201. 

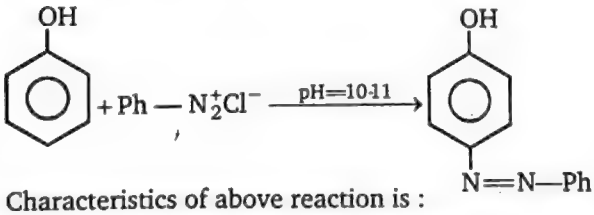
Identify major product of both respectively.

(a) 

(b) 

(c) 

(d) 

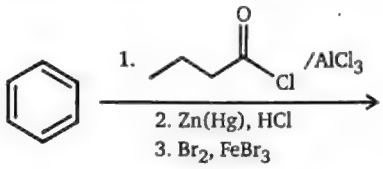
202. 

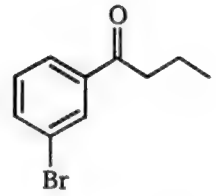
Characteristics of above reaction is :
(a) C — N coupling reaction ; Carbocation is intermediate
(b) N — N coupling reaction ; Carbocation is intermediate
(c) C — N coupling reaction ; Carbanion is intermediate
(d) N — N coupling reaction ; Carbanion is intermediate

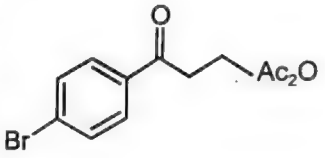
203. The compound formed on heating chlorobenzene with chloral in the presence of concentrated sulphuric acid, is :

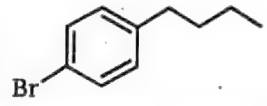
(a) Freon (b) DDT (c) Gammexene (d) Hexachloroethane

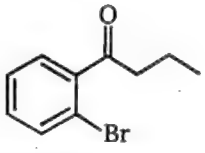
204. Predict the product of the following reaction.



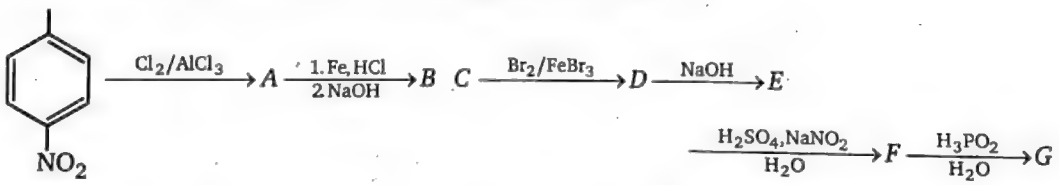
(a) 

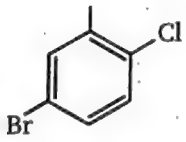
(b) 

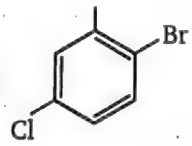
(c) 

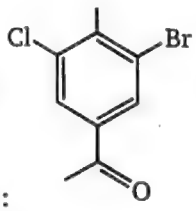
(d) 

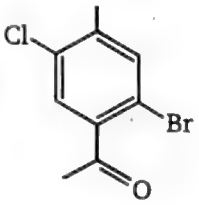
205. Predict the major product of the following reaction sequence.



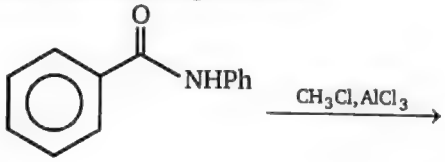
(a) 

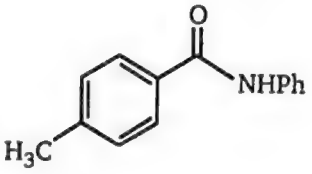
(b) 

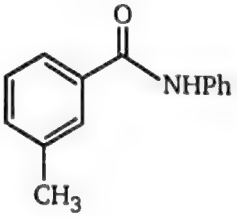
(c) 

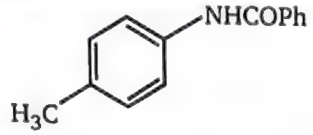
(d) 

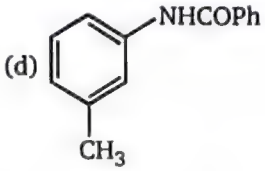
206. Give the major product of the following reaction :

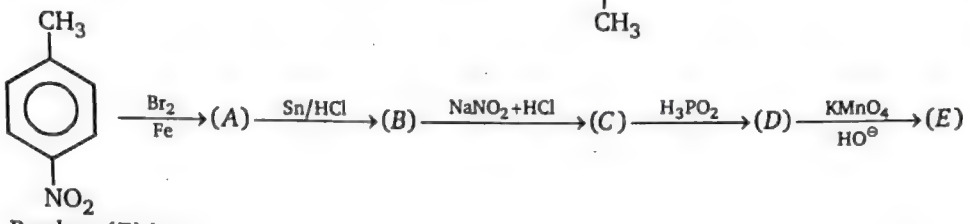


(a) 

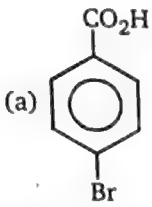
(b) 

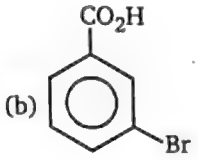
(c) 

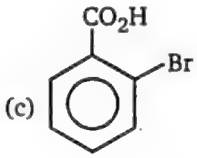
(d) 

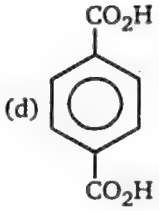
207. 

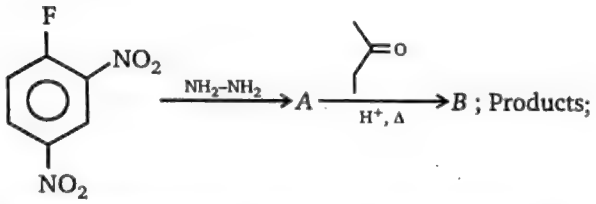
Product (*E*) is :

(a) 

(b) 

(c) 

(d) 

208. 

Incorrect statements regarding above reaction is

(a) Product *A* is 2, 4-DNP

(b) *A* to *B* dehydration reaction

(c) *A* to *B*, geometrical isomersm will obtained as a product

(d) B is known as oxime

209. (i) chlorobenzene is mono-nitrated to M

(ii) nitrobenezene is mono-chlorinated to N

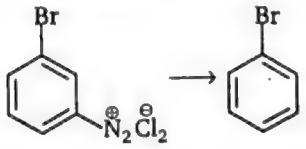
(iii) anisole is mono-nitrated to P

(iv) 2-nitrochlorobenzene is mono-nitrated to Q.

Out of M, N, P and Q the compound that undergoes reaction with aq. NaOH fastest is

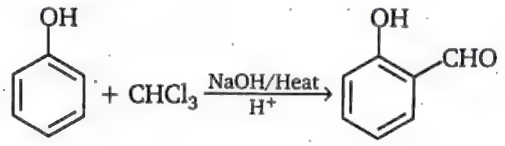
(a) M (b) N (c) P (d) Q

210. For the transformation the reagent used is



(a) $LiAlH_4$ (b) H_3PO_2 (c) H_3O^+ (d) H_2 / Pt

211. The reaction



is known as

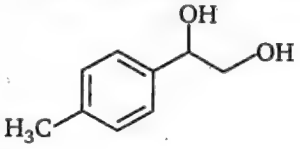
(a) Perkin reaction (b) Sandmeyer reaction

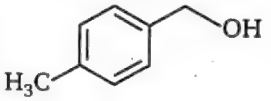
(c) Reimer-Tiemann reaction (d) Cannizzaro reaction

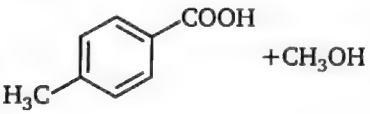
212. A compound X formed after heating coke with lime react with water to give *Y* which on passing over redhot iron at 873 produces *Z*. The compound *Z* is

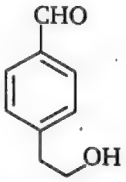
(a)  (b)  (c)  (d) 

213. The reaction of 50% aq KOH on an equimolar mixture of 4-methylbenzaldehyde and formaldehyde followed by acidification gives :

(a) 

(b) 

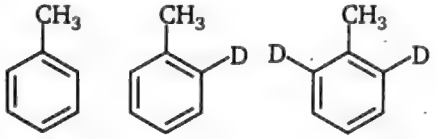
(c) 

(d) 

214. Which isomer of xylene can give three different monochloroderivatives ?

(a) o-xylene (b) m-xylene (c) *p*-xylene

(d) xylene cannot give a monochloro derivative

215. 

(I) (II) (III)

The rate of o-nitration of the above compounds, (I) toluene, (II) 2-D-toluene and (III) 2, 6-D_2-toluene is in the following order

(a) I > II > III (b) II > I > III (c) III > I > II

(d) The rate is the same for all the three compounds

216. Cyclooctatetraene is expected to have :

(a) a planar structure (b) a tub-shaped structure

(c) open chain isomeric structure (d) tatutomeric bicyclic structure

ANSWERS — LEVEL 1

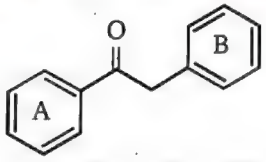
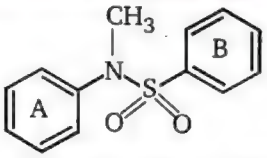
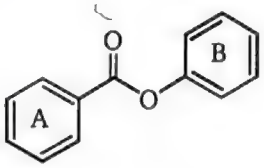
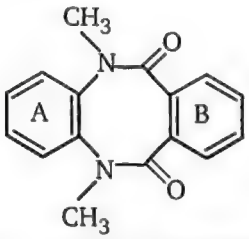
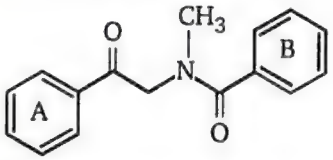
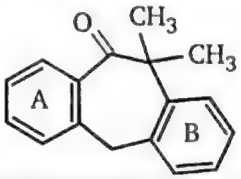
1.	(b)	**2.**	(d)	**3.**	(b)	**4.**	(c)	**5.**	(a)	**6.**	(b)	**7.**	(c)	**8.**	(b)
9.	(d)	**10.**	(d)	**11.**	(a)	**12.**	(a)	**13.**	(a)	**14.**	(a)	**15.**	(a)	**16.**	(b)
17.	(b)	**18.**	(a)	**19.**	(b)	**20.**	(b)	**21.**	(c)	**22.**	(c)	**23.**	(b)	**24.**	(b)
25.	(d)	**26.**	(c)	**27.**	(c)	**28.**	(b)	**29.**	(b)	**30.**	(b)	**31.**	(b)	**32.**	(a)
33.	(b)	**34.**	(d)	**35.**	(c)	**36.**	(c)	**37.**	(a)	**38.**	(c)	**39.**	(a)	**40.**	(b)
41.	(b)	**42.**	(c)	**43.**	(c)	**44.**	(b)	**45.**	(c)	**46.**	(b)	**47.**	(b)	**48.**	(b)
49.	(b)	**50.**	(b)	**51.**	(b)	**52.**	(a)	**53.**	(c)	**54.**	(c)	**55.**	(a)	**56.**	(a)
57.	(d)	**58.**	(b)	**59.**	(b)	**60.**	(b)	**61.**	(c)	**62.**	(b)	**63.**	(b)	**64.**	(b)
65.	(a)	**66.**	(a)	**67.**	(c)	**68.**	(b)	**69.**	(a)	**70.**	(d)	**71.**	(b)	**72.**	(a)
73.	(a)	**74.**	(c)	**75.**	(a)	**76.**	(d)	**77.**	(c)	**78.**	(b)	**79.**	(c)	**80.**	(b)
81.	(b)	**82.**	(c)	**83.**	(a)	**84.**	(c)	**85.**	(d)	**86.**	(b)	**87.**	(d)	**88.**	(b)
89.	(d)	**90.**	(d)	**91.**	(d)	**92.**	(d)	**93.**	(d)	**94.**	(b)	**95.**	(c)	**96.**	(d)
97.	(b)	**98.**	(d)	**99.**	(b)	**100.**	(b)	**101.**	(b)	**102.**	(c)	**103.**	(d)	**104.**	(a)
105.	(b)	**106.**	(d)	**107.**	(c)	**108.**	(b)	**109.**	(b)	**110.**	(b)	**111.**	(c)	**112.**	(b)
113.	(c)	**114.**	(a)	**115.**	(b)	**116.**	(b)	**117.**	(a)	**118.**	(b)	**119.**	(b)	**120.**	(c)
121.	(b)	**122.**	(b)	**123.**	(c)	**124.**	(b)	**125.**	(b)	**126.**	(b)	**127.**	(c)	**128.**	(c)
129.	(c)	**130.**	(b)	**131.**	(d)	**132.**	(b)	**133.**	(b)	**134.**	(a)	**135.**	(b)	**136.**	(a)
137.	(b)	**138.**	(c)	**139.**	(d)	**140.**	(b)	**141.**	(b)	**142.**	(c)	**143.**	(a)	**144.**	(b)
145.	(b)	**146.**	(c)	**147.**	(a)	**148.**	(c)	**149.**	(c)	**150.**	(b)	**151.**	(d)	**152.**	(c)
153.	(c)	**154.**	(b)	**155.**	(c)	**156.**	(c)	**157.**	(c)	**158.**	(b)	**159.**	(c)	**160.**	(c)
161.	(b)	**162.**	(c)	**163.**	(d)	**164.**	(d)	**165.**	(c)	**166.**	(c)	**167.**	(b)	**168.**	(d)
169.	(d)	**170.**	(b)	**171.**	(b)	**172.**	(a)	**173.**	(a)	**174.**	(b)	**175.**	(b)	**176.**	(d)
177.	(b)	**178.**	(b)	**179.**	(c)	**180.**	(a)	**181.**	(b)	**182.**	(d)	**183.**	(a)	**184.**	(c)
185.	(c)	**186.**	(b)	**187.**	(b)	**188.**	(b)	**189.**	(a)	**190.**	(b)	**191.**	(d)	**192.**	(b)
193.	(c)	**194.**	(a)	**195.**	(c)	**196.**	(b)	**197.**	(b)	**198**	(b)	**199**	(d)	**200**	(e)
201.	(c)	**202.**	(c)	**203.**	(b)	**204.**	(c)	**205.**	(a)	**206.**	(c)	**207.**	(c)	**208.**	(d)
209.	(d)	**210.**	(a)	**211.**	(c)	**212.**	(a)	**213.**	(b)	**214**	(b)	**215.**	(d)	**216.**	(b)

LEVEL-2

1. Each of the six compounds shown at the bottom of the page has two aromatic (benzene) rings. In each case the two rings are different and are labeled A & B. **If an electrophilic substitution, such as nitration or bromination**, is carried out on each compound, then identify which ring (A or B) will be preferentially attacked, and indicate the orientation of the substitution (ortho/para, meta or all sites).

Compound	Reactivity		Substitution	
1.	A		ortho/para	
	B		meta	
			all sites	
3.	A		ortho/para	
	B		meta	
			all sites	
5.	A		ortho/para	
	B		meta	
			all sites	

Compound	Reactivity		Substitution	
2.	A		ortho/para	
	B		meta	
			all sites	
4.	A		ortho/para	
	B		meta	
			all sites	
6.	A		ortho/para	
	B		meta	
			all sites	

	Compound		Compound
1.		2.	
3.		4.	
5.		6.	

2. When given substituents on a benzene ring, as activating or de-activating and as ortho-para or meta directing for elctrophilic aromatic substitution fill the following by appropriate (✓) right or (✗) wrong.

	Substituent	Activating	De-activating	Ortho/para	Meta
1.	$-OCH_3$				
2.	$-\overset{\overset{O}{\|}}{C}-O-CH_3$				
3.	$-O-\overset{\overset{O}{\|}}{C}-CH_3$				
4.	$-CH_3$				
5.	$-F$				
6.	$-Ph$				
7.	$-NH-\overset{\overset{O}{\|}}{C}-CH_3$				
8.	$-\overset{\overset{O}{\|}}{C}-NH-CH_3$				
9.	$-Br$				
10.	$-CN$				
11.	$-CF_3$				
12.	$-\overset{\overset{O}{\|}}{C}-NH_2$				
13.	$-\overset{\overset{O}{\|}}{C}-OH$				
14.	$-CH=CH_2$				

15.	$-CH=CH-\overset{\overset{O}{\|\|}}{C}-OH$				
16.	$-CH=CH-\overset{\overset{O}{\|\|}}{C}-H$				
17.	$-S-Et$				
18.	$-\overset{\overset{O}{\|\|}}{S}-Et$				
19.	$-\overset{\overset{O}{\|\|}}{\underset{\underset{O}{\|\|}}{S}}-Et$				
20.	$-N=O$				
21.	$-CH_2X$				
22.	$-CHX_2$				

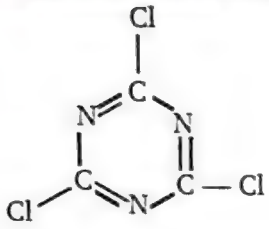
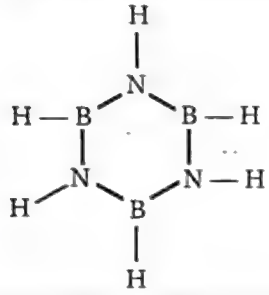
3. Devise a series of reactions to convert benzene into *meta*-chlorobromobenzene.

Select reagents and conditions from the following table, listing them in the order of use.

	Compound		Compound		Compound
1.	sulphuric acid (conc.) heat	**5.**	Mg in ether	**9.**	Cu_2Br_2 + HBr
2.	Cl_2 + $FeCl_3$ and heat	**6.**	PBr_3	**10.**	$(CH_3CO)_2O$ + Pyridine
3.	$NaNO_2$ + $H_3O^{(+)}$ 0°C	**7.**	H_3PO_2		
4.	H_2 Pt catalyst	**8.**	HNO_3(conc.)+ H_2SO_4(conc.) and heat		

(a) 1 then 2 then 6
(b) 2 then 8 then 4 then 3 then 9
(c) 8 then 4 then 10 then 2 then 3 then 9
(d) 8 then 2 then 4 then 3 then 9

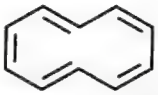
4. Match the Column (I) and Column (II). (Matrix)

Column (I)		Column (II)	
(a)		**(p)**	Aromatic
(b)		**(q)**	$(4n+2)\pi$ electron in a single ring
(c)	$Fe(C_5H_5)_2$	**(r)**	$4n\pi$ electron in a single ring
(d)	$Cr(C_6H_6)_2$	**(s)**	Effective atomic number of metal = 36

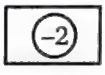
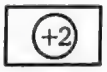
5. Match the Column (I) and Column (II).

Column (I)		Column (II)	
Compound (Monocyclic)		**Number of π- electron**	
(a)	$C_4H_4^{-2}$	**(p)**	$2\pi e$
(b)	$C_4H_4^{+2}$	**(q)**	$6\pi e$
(c)	$C_9H_9^{+1}$	**(r)**	$8\pi e$
(d)	$C_9H_9^{-1}$	**(s)**	$10\pi e$

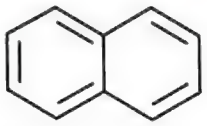
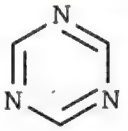
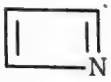
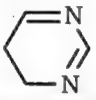
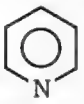
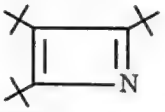
6. Match the Column (I), Column (II) and Column (III). (Matrix)

Column I		Column II		Column III	
(a)		(p)	Aromatic	(w)	$(4n + 2)\pi$ electron. $n = 0, 1, 2, 3$
(b)		(q)	Non-aromatic	(x)	$4n\pi$ electron $n = 1, 2, 3$
(c)		(r)	Anti- aromatic	(y)	Non-planar compound
(d)		(s)	Planar compound	(z)	Readily reacts with active metal

7. Match the Column (I), Column (II) and Column (III). (Matrix)

Column I		Column II		Column III	
(a)		(p)	Readily react with active metal	(w)	Aromatic
(b)		(q)	Readily undergo Dimerization at room temperature	(x)	Anti-aromatic
(c)		(r)	$(4n + 2)\pi$ electron $n = 0, 1, 2, 3$	(y)	Non-aromatic
(d)		(s)	$4n\pi$ electron	(z)	High dipole

8. Among the following compound.

	Compound		Compound		Compound
(a)		**(b)**		**(c)**	
(d)		**(e)**		**(f)**	
(g)	$C_8H_8^{-2}$	**(h)**	$C_3H_3^+$	**(i)**	
(j)		**(k)**		**(l)**	

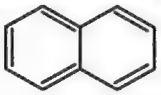
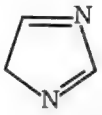
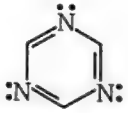
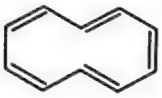
(a) Number of compounds which are aromatic = P
(b) Number of compounds which are anti-aromatic = Q
(c) Number of compounds which are non-aromatic = R
(d) Number of compounds which readily = S
Undergo dimerization at room temperature
(e) Number of compound which reacts with active metal = T

Sum of $P+Q+R+S+T$ =

9. Of the following compounds which will react with Br_2 at room temperature in dark.

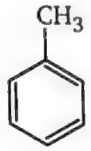
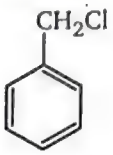
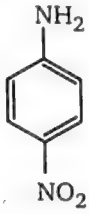
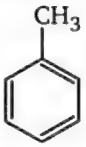
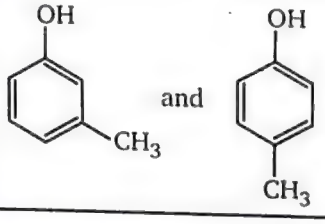
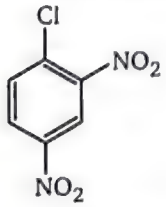
(a)	Benzene (C_6H_6)	
(b)	Cyclohexene (C_6H_{10})	
(c)	Cyclohexane (C_6H_{12})	
(d)	Propanoic Acid ($C_2H_5CO_2H$)	
(e)	Phenol (C_6H_5OH)	
(f)	Nitrobenzene ($C_6H_5NO_2$)	
(g)	Hexyne (C_6H_{10})	
(h)	2,2-dichloropropane ($C_3H_6Cl_2$)	

10. Among the following compound.

	Compound		Compound		Compound
(a)		**(b)**	$C_8H_8^{-2}$	**(c)**	
(d)		**(e)**		**(f)**	
(g)		**(h)**		**(i)**	$C_3H_3^{+1}$
(j)		**(k)**		**(l)**	

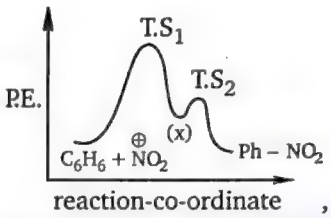
(a) Number of compounds which are aromatic = w
(b) Number of compounds which are non-aromatic = x
(c) Number of compounds which are anti-aromatic = y
(d) Number of compounds which readily undergo Dimerization at room temperature = z
Sum of $w + x + y + z$ = ...

11. Complete the following table.

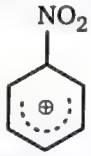
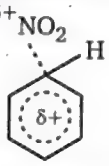
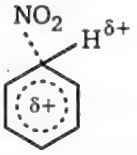
	Reactant	Reagents(s)/Conditions	Major Organic Products
(a)		**(A)**	
(b)		1. $NaNO_2$ in dilute H_2SO_4/0 – 5 °C 2. heat or boiling	**(B)**
(c)		SO_3/conc. H_2SO_4	**(C)**
(d)	**(D)**	1. NaOH heated at 330°C 2. dilute H_3O^+	
(e)		1. aqueous NaOH heated at 60°C 2. dilute H_3O^+	**(E)**

12. Comprehension

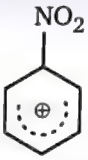
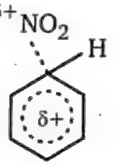
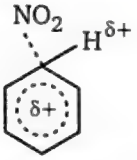
Given is the energy profile diagram of nitration of benzene using mixed acid. ($HNO_3 + H_2SO_4$).



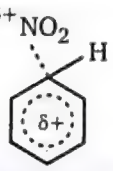
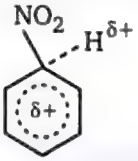
A. Identify (x) in above reaction :

(a)  (b)  (c)  (d) None

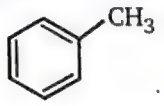
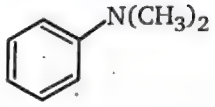
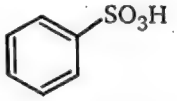
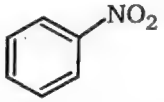
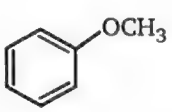
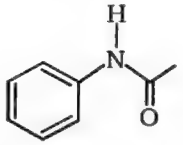
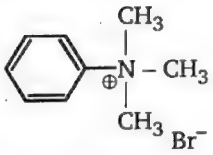
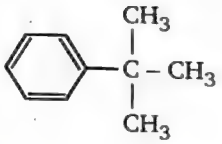
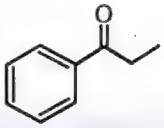
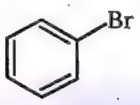
B. Identify $T.S_1$ in the above reaction.

(a)  (b)  (c)  (d) None

C. Identify $T.S_2$ in the above reaction :

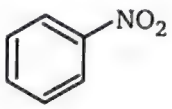
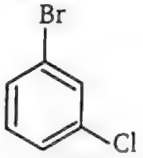
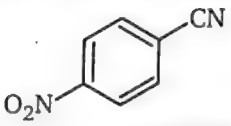
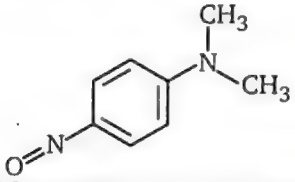
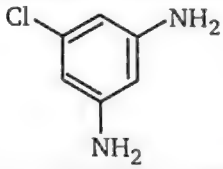
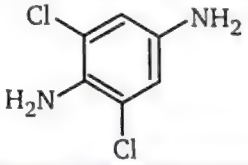
(a)  (b)  (c)  (d) None

13. Examine the ten structural formulas shown below and select those that satisfy each of the following conditions. Enter one or more letters (a through j) in each answer box, reflecting your choice for each.

	Compound		Compound
a.		**b.**	
c.		**d.**	
e.		**f.**	
g.		**h.**	
i.		**j.**	

A.	Which compounds undergo electrophilic nitration more rapidly than benzene ?	
B.	Which compounds give meta substitution under electrophilic bromination conditions ?	

14. Nitrobenzene is a versatile compound that may be converted into a wide variety of substituted benzenes. Five such synthesis are shown below. In each reaction box above an arrow write letters designating the reagents and conditions, selected from the list at the bottom of the page, that would effect the transformation. The reagents must be written in the answer box in the correct order of their use. You may assume appropriate heating or cooling takes place, and more than one equivalent of the reagent may be used if needed.

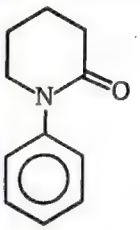
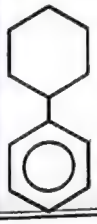
Reactant	Reagent		Product
 nitrobenzene	**a.** ⟶	**v.**	
	b. ⟶	**w.**	
	c. ⟶	**x.**	
	d. ⟶	**y.**	
	e. ⟶	**z.**	

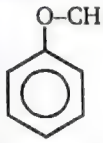
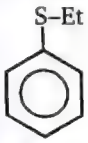
Reagents		Reagents	
A.	H_2, Ni catalyst	**F.**	Cl_2 & $FeCl_3$
B.	KBr & Cu_2Br_2	**G.**	NaOH 10% solution
C.	KCN & $Cu_2(CN)_2$	**H.**	$(CH_3CO)_2O$, pyridine
D.	HNO_2 0°C	**I.**	HNO_3/H_2SO_4
E.	CH_3I & pyridine		

15. Match the column I and II.

Column (I)		Column (II)	
Group		**Effect on phenyl ring**	
(a)	$-CH=CH-CO_2H$	**(p)**	*o/p*-directors
(b)	$-O-\overset{\overset{O}{\|\|}}{S}-CH_3$	**(q)**	meta-directors
(c)	$-NH-\overset{\overset{O}{\|\|}}{C}-CH_3$	**(r)**	Activating group
(d)	$-\overset{\overset{O}{\|\|}}{S}-CH_3$	**(s)**	De-activating group

16. Match the column I and II.

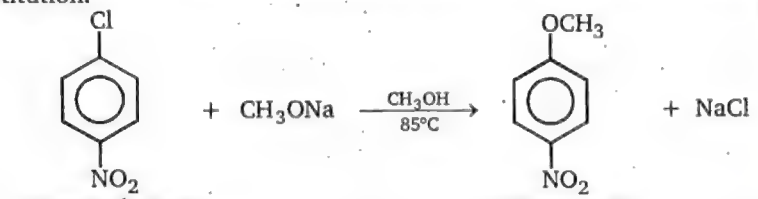
Column (I)		Column (II)	
Group		**Effect on phenyl group**	
(a)		**(p)**	Activating group
(b)		**(q)**	De-activating group

(c)		(r)	*o/p*-director
(d)		(s)	meta-director

17. Comprehension

Nucleophilic Aromatic substitution (SN_{Ar}) :

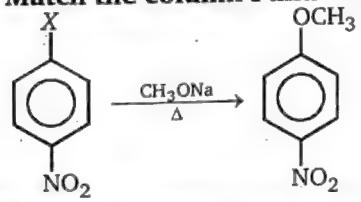
A substituted benzene derivative containing- NO_2 and Cl group at *p*-position is subjected to Nu-substitution.



p-chloronitrobenzene

(*p*-Nitroanisole)
(92%)

A. Match the column I and II :

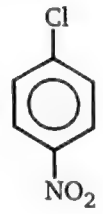


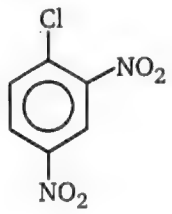
Column (I)		Column (II)	
***X* = halogen**		**relative reactivity toward (SN_{Ar}).**	
(a)	– F	**(p)**	312
(b)	– Cl	**(q)**	1
(c)	– Br	**(r)**	0.8
(d)	– I	**(s)**	0.6

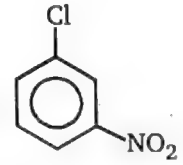
B. If step-2 were rate determining step, which halogen of aryl halide is most reactive toward SN_{Ar}.

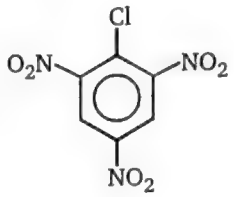
(a) Fluoride (b) Chloride (c) Bromide (D) Iodide

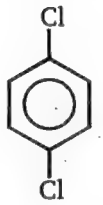
C. Which of the following is most reactive toward SN_{Ar}.

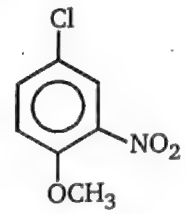
(a) 

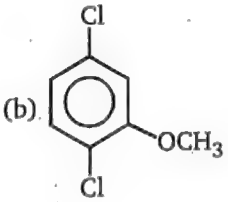
(b) 

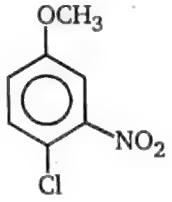
(c) 

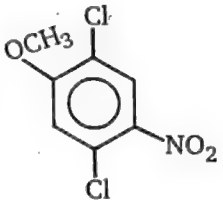
(d) 

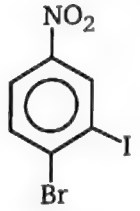
D.  $\xrightarrow{HNO_3}$ (*A*) $\xrightarrow{CH_3ONa}$ (*B*) (Major) , product (*B*) is :

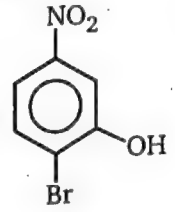
(a) 

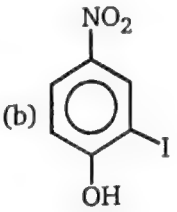
(b) 

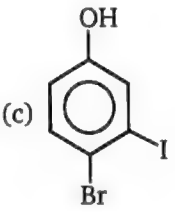
(c) 

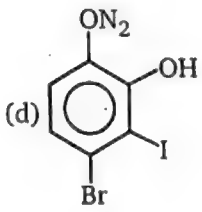
(d) 

E.  $\xrightarrow[(2)\ H_3O^{\oplus}]{(1)\ NaOH,\ \Delta}$ (*A*) , Product (*A*) is :

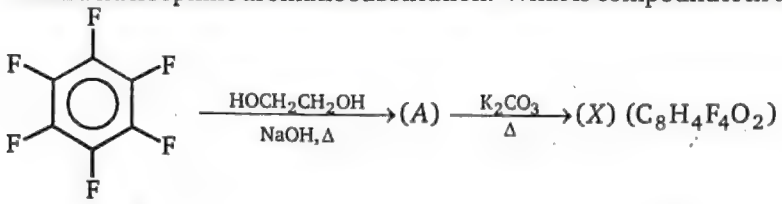
(a) 

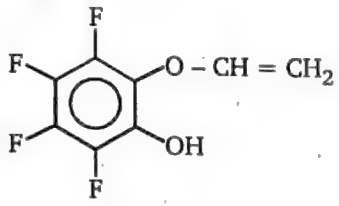
(b) 

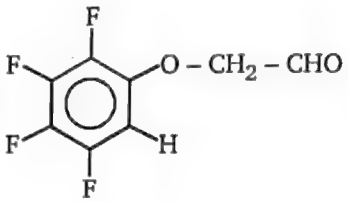
(c) 

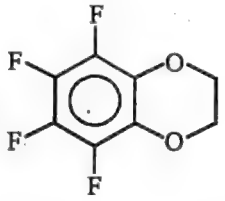
(d) 

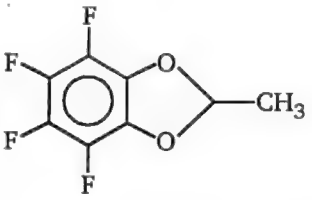
F. The cumulative effect of their fluorine activate the rings of penta and hexa fluorobenzene toward nucleophilic aromatic substitution. What is compound *X* in the following synthesis ?

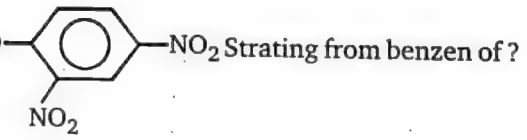


(a) 

(b) 

(c) 

(d) 

G. Which is the best route for the synthesis of 

Strating from benzen of ?

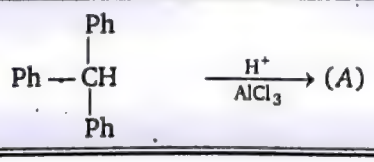
(a) $\xrightarrow[FeBr_3]{Br_2} \xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[CH_3OH]{NaOCH_3}$

(b) $\xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[FeBr_3]{Br_2} \xrightarrow[CH_3OH]{NaOCH_3}$

(c) $\xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[FeBr_3]{Br_2} \xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[CH_3OH]{NaOCH_3}$

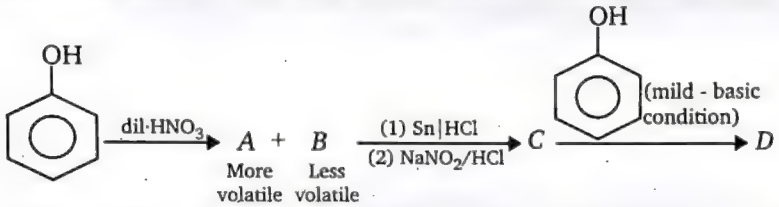
(d) $\xrightarrow[H_2SO_4]{HNO_3} \xrightarrow[FeBr_3]{Br_2} \xrightarrow[CH_3OH]{NaOCH_3} \xrightarrow[H_2SO_4]{HNO_3}$

18. Identify product (*A*) and write its structure.



SUBJECTIVE PROBLEMS

1.



Double bond equivalent of *D* is :

2. How many isomers '*x*' of C_8H_{10} when reacts with hot alkaline $KMnO_4$ give only aromatic dicarboxylic acid ? How many isomers '*y*' of C_4H_8 when reacts with hot alkaline $KMnO_4$ give carbondioxide ?
Sum of $x+y$=?

3. How many groups are *o*/*p* director in the electrophilic aromatic substitution ?

(i) $-NH_2$ (ii) $-COH$ (iii) $-N=O$ (iv) $-COOH$

(v) $-OMe$ (vi) $-O-\overset{\overset{O}{\|}}{C}-Me$ (vii) $-Et$ (viii) $-\overset{\overset{O}{\|}}{C}-NH-Me$

(ix) $-N=NH_2$ (x) $-SO_3H$

ANSWERS — LEVEL 2

1.

Compound	Reactivity	Substitution
1	B	ortho/para
2	A	ortho/para
3	B	ortho/para
4	A	ortho/para
5	B	meta
6	B	ortho/para

2.

	Substituent	Activating	De-activating	Ortho/para	Meta
1.	$-OCH_3$	✓	✗	✓	✗
2.	$-\overset{\overset{O}{\|\|}}{C}-O-CH_3$	✗	✓	✗	✓
3.	$-O-\overset{\overset{O}{\|\|}}{C}-CH_3$	✓	✗	✓	✗
4.	$-CH_3$	✓	✗	✓	✗
5.	$-F$	✗	✓	✓	✗
6.	$-Ph$	✓	✗	✓	✗
7.	$-NH-\overset{\overset{O}{\|\|}}{C}-CH_3$	✓	✗	✓	✗
8.	$-\overset{\overset{O}{\|\|}}{C}-NH-CH_3$	✗	✓	✗	✓
9.	$-Br$	✗	✓	✓	✗
10.	$-CN$	✗	✓	✗	✓

11.	$-CF_3$	✗	✓	✗	✓
12.	$-\overset{\overset{O}{\|\|}}{C}-NH_2$	✗	✓	✗	✓
13.	$-\overset{\overset{O}{\|\|}}{C}-OH$	✗	✓	✗	✓
14.	$-CH=CH_2$	✓	✗	✓	✗
15.	$-CH=CH-\overset{\overset{O}{\|\|}}{C}-OH$	✗	✓	✓	✗
16.	$-CH=CH-\overset{\overset{O}{\|\|}}{C}-H$	✗	✓	✓	✗
17.	$-S-Et$	✓	✗	✓	✗
18.	$\begin{matrix}-S-Et\\ \\ \overset{\overset{O}{\|\|}}{}\end{matrix}$	✗	✓	✓	✗
19.	$\begin{matrix}\overset{\overset{O}{\|\|}}{}\\ -S-Et\\ \\ \overset{\overset{O}{\|\|}}{}\end{matrix}$	✗	✓	✗	✓
20.	$-N=O$	✗	✓	✓	✗
21.	$-CH_2X$	✗	✓	✗	✓
22.	$-CHX_2$	✗	✓	✗	✓

3. d

4. a – p, q; b – p, q; c – p, q,s ; d – p, q, s

5. a – q; b – p; c – r; d – s

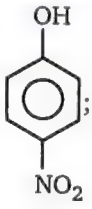
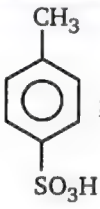
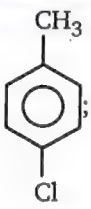
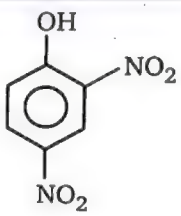
6. a – p, s – w; b – p, s – w; c – q – x, y, z; d – q – w – y

7. a – p, q, s – x; b – p – s – y; c – r – w, z; d – r – w, z

8. $P+Q+R+S+T=19$

9. b, e, g

10. $w+x+y+z=14$

11. A – $Cl_2/h\nu$ or $SO_2Cl_2/h\nu$; B –  ; C –  ; D –  ; E – 

12. A – a; B – b; C – c

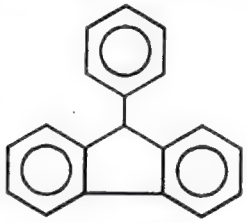
13. A – a, b, e, f, h; B – c, d, g, i (Note : yet C_6H_5Br is less reactive than C_6H_6 but *o*/*p* directing)

14. v – F, A, D, B; w – A, H, I, G, D, C; x – A, E, D; y – F, I, A or I, F, A;
z – A, H, I, F, G, A or A, H, I, F, A, G

15. a – p, s; b – p, r; c – p, r; d – p, s

16. a – p, r; b – p, r; c – p, r; d – p, r

17. A –a – p, b – q, c – r, d – s; B – d; C – d; D – a; E – b; F – c; G – a

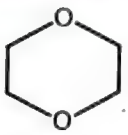
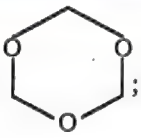
18. 

Subjective Problems

1. 9 **2.** 5 **3.** 6

13 PRACTICAL ORGANIC CHEMISTRY

LEVEL-1

1.  and  ; Compounds (*X*) and (*Y*) can be differentiated by :

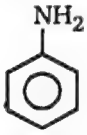
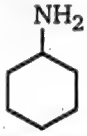
(*X*) (*Y*)

(a) $H_3O^{\oplus}$, NaOI
(b) $H_3O^{\oplus}$, then Fehling test
(c) $H_3O^{\oplus}$, then Na
(d) Both (b) and (c)

2. Compound $CH_3 - CH(OEt)_2$ and $CH_3 - CH_2 - O - CH_2 - CH_3$ can be differentiated by :

(*P*) (Acetal) **(*Q*)**

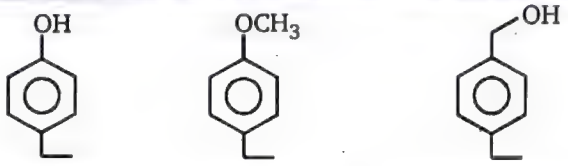
(a) $H_3O^{\oplus}$, Na
(b) $H_3O^{\oplus}$, Tollens' test
(c) $H_3O^{\oplus}$, Fehling test
(d) All of these

3.  and  can be differentiated by :

(aniline) (cyclohexyl amine)

(a) Hinsberg test
(b) Iso-cyanide test
(c) $NaNO_2$, HCl, then β-Naphthol
(d) NaOH

4.



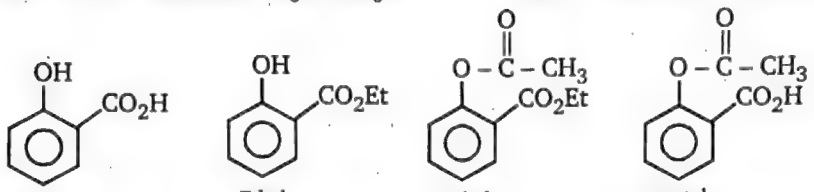
(*p*-ethyl phenol) (*p*-methyl anisole) (*p*-ethyl benzyl alcohol)

Above compounds can be differentiated by using the reagent:

(a) NaOH, Tollen's reagent, $FeCl_3$ (b) CrO_3, Tollen's reagent, $FeCl_3$

(c) Tollen's reagent, CrO_3, $FeCl_3$ (d) Na, Tollen's reagent, $FeCl_3$

5.



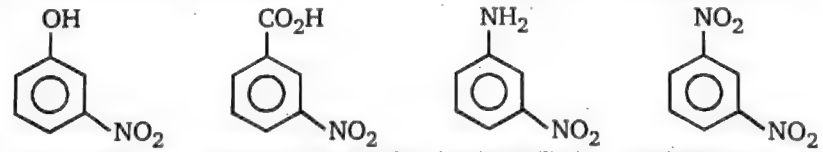
Salicyclic acid | Ethyl salicylate | Ethyl acetyl | acetyl salicyclic acid

Above compounds can be differentiated by the salicylate. Which of the following chemical test? (used in decreasing order)

(a) NaOH, $FeCl_3$, $NaHCO_3$ (b) aq. $NaHCO_3$, $FeCl_3$, NaOH

(c) NaOI, NaOH, $NaHCO_3$ (d) NaOH, Na, $NaHCO_3$

6.



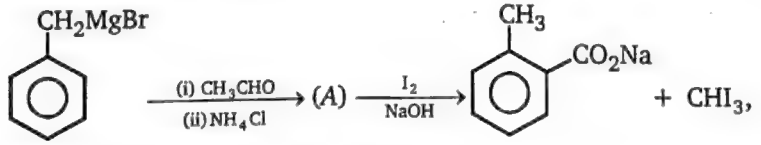
(*m*-nitrophenol) (*m*-nitro benzoic acid) (*m*-nitro aniline) (*m*-dinitro benzene)

Above compounds can be differentiated by which of the following chemical test ? (used in decreasing order)

(a) NaOH, $NaHCO_3$, HCl (b) HCl, NaOH, $NaHCO_3$

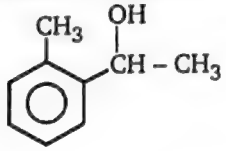
(c) $NaHCO_3$, NaOH, HCl (d) NaOH, HCl, $NaHCO_3$

7.

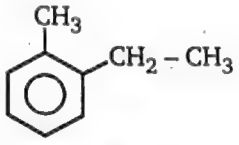


Product (*A*) in the above reaction is :

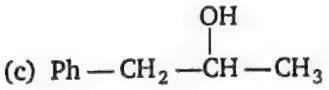
(a)



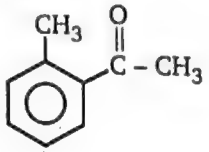
(b)

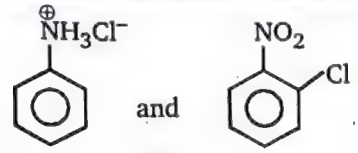


(c)



(d)



8.  and

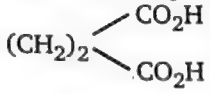
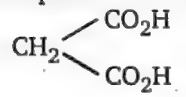
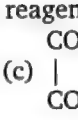
(P) (Q)

Above compounds (P) & (Q) can be differentiated by :

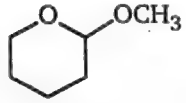
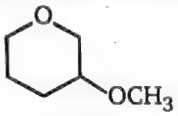
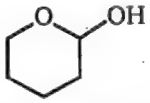
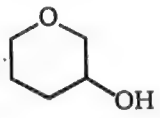
(a) amm. $AgNO_3$ (b) NaOH

(c) $FeCl_3$ (d) Both (a) & (b)

9. Which of following acid give positive Tollen's reagent test.

(a)  (b)  (c)  (d) HCO_2H

10. Which of following compounds give positive Tollen's test?

(a)  (b)  (c)  (d) 

11. Give a simple test to differentiate cyclohexane and cyclohexene

(a) Br_2/H_2O (b) Bayer's reagent

(c) Tollen's reagent (d) Both (a) and (b)

12. Give test to differentiate (Bromobenzene) Ph – Br and benzyl bromide ($PhCH_2Br$).

(a) (i) aq. KOH (ii) Na (b) $AgNO_3$

(c) $KMnO_4$ (d) All these

13. Give test to differetiate 1,1-dichloroethane and 1, 2-dichloroethane :

(a) 2,4 -DNP then aq. KOH (b) aq. KOH then 2, 4-DNP

(c) $NaHSO_3$ (d) Lucas reagent

14. Test to differentiate between $\underset{\text{(methanol)}}{(CH_3OH)}$ and $\underset{\text{(Phenol)}}{(Ph-OH)}$ is/are :

(a) Litmus test (b) $FeCl_3$

(c) Br_2/H_2O (d) All of these

15. Acetaldehyde and benzaldehyde can be differentiated by :

(a) Fehling test (b) Iodoform test

(c) Tollen's reagent (d) both (a) and (b)

16. Ethylamine and diethylamine cannot be differentiated by :

(a) Hinsberg test (b) carbylamine test

(c) Iodoform test (d) both (a) and (b)

17. Lassaigne's test for the detection of nitrogen will fail in the case of :

(a) NH_2CONH_2 (b) $NH_2CONHNH_2.HCl$

(c) $NH_2NH_2.HCl$ (d) $C_6H_5NHNH_2.\ 2HCl$

18. Sodium nitroprusside when added to an alkaline solution of sulphide ions produces a colouration which is :
(a) red (b) blue (c) brown (d) purple

19. In Kjeldahl's method, nitrogen present is estimated as :
(a) N_2 (b) NH_3 (c) NO_2 (d) none of these

20. In Kjeldahl's method of estimation of nitrogen, K_2SO_4 acts as :
(a) an oxidising agent (b) catalytic agent
(c) hydrolysing agent (d) boiling point elevator

21. The prussian blue colour obtained during the test of nitrogen by Lassaigne's test is due to the formation of :
(a) $Fe[Fe(CN)_6]_3$ (b) $Na_3[Fe(CN)_6]$
(c) $Fe(CN)_3$ (d) $Na_4[Fe(CN)_5NOS]$

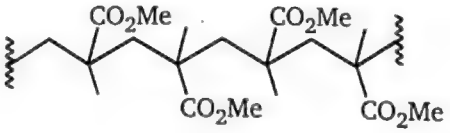
22. A compound which does not give a positive test in Lassaigne's test for nitrogen is:
(a) urea (b) hydrazine (c) azobenzene (d) phenyl hydrazine

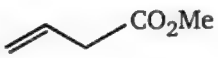
23. *p*-nitrophenol and *o*-nitrophenol are separated by :
(a) distillation (b) steam distillation
(c) crystallization (d) fractional crystallization

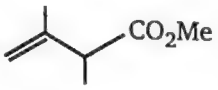
24. Which of the following reagent is used for the separation of acetaldehyde from acetophenone ?
(a) NH_2OH (b) NaOI (c) Tollen's reagent (d) $C_6H_5NHNH_2$

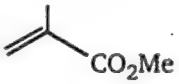
25. The formula of gas is $[CO]_x$. If its vapour density is 70, the value of x will be :
(a) 2.5 (b) 3.0 (c) 5.0 (d) 6.0

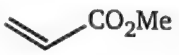
26. The structure of the monomer that would give the following polymer by an addition mechanism is :



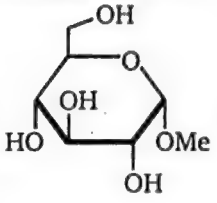
(a) 

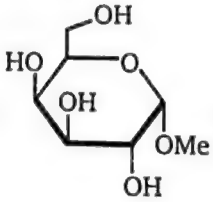
(b) 

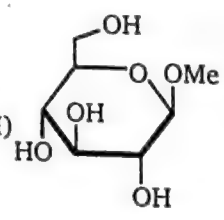
(c) 

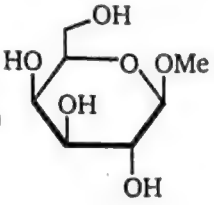
(d) 

27. Identify the correct set of stereochemical relationships amongst the following monosaccharides I – IV

(I) 

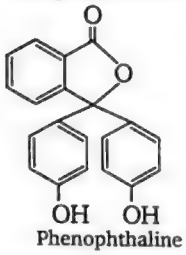
(II) 

(III) 

(IV) 

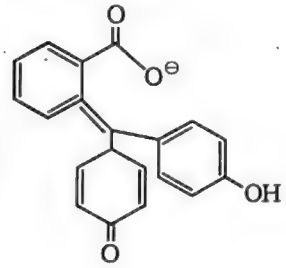
(a) I and II are anomers ; III and IV are epimers
(b) I and II are epimers ; III and IV are anomers
(c) I and III are anomers ; I and II are epimers
(d) I and III are epimers ; II and IV are anomers

28. A dye, phenolphtnalein is prepared by reacting phenol with phthalic anhydride in acidic medium. It give pink colour in alkaline medium due to extended conjugation in a new complex formed (phthalein - dye test) identify the complex *A* :



Phenophthaline

$\xrightarrow{\ominus OH}$ (*A*) Product ; The structure of (*A*) is:

(a)


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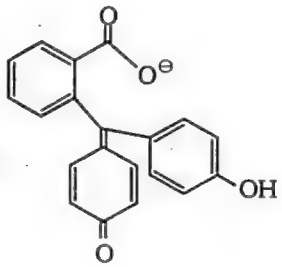

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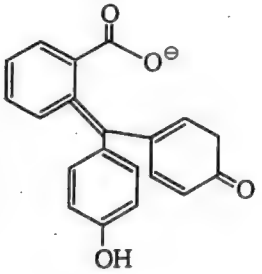


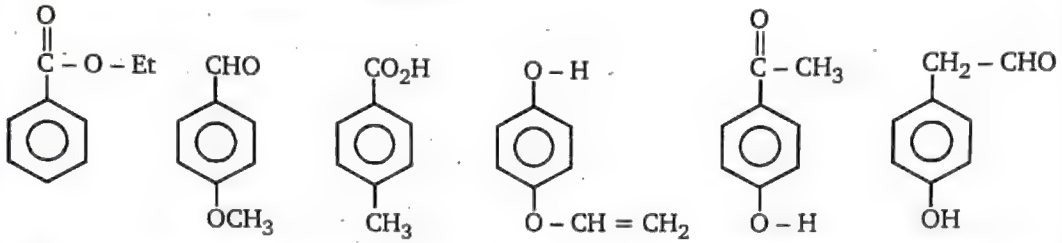
(d) None

ANSWERS — LEVEL 1															
1.	(d)	**2.**	(d)	**3.**	(c)	**4.**	(b)	**5.**	(b)	**6.**	(c)	**7.**	(a)	**8.**	(d)
9.	(d)	**10.**	(c)	**11.**	(d)	**12.**	(d)	**13.**	(b)	**14.**	(d)	**15.**	(d)	**16.**	(c)
17.	(c)	**18.**	(b)	**19.**	(b)	**20.**	(d)	**21.**	(d)	**22.**	(b)	**23.**	(a)	**24.**	(c)
25.	(c)	**26.**	(c)	**27.**	(c)	**28.**	(b)								

LEVEL-2

1. Comprehension

Given are the isomers of $C_8H_8O_2$.



(a) (b) (c) (d) (e) (f)

A. Which isomer gives positive iodoform test ?

(a) a (b) b
(c) d (d) e

B. Which isomer gives +ive Tollen's test, also reacts with $FeCl_3$?

(a) b (b) f
(c) c (d) d

C. Which isomer reacts with $NaHCO_3$?

(a) c (b) d
(c) e (d) f

D. Which isomer on hydrolysis gives 1, 4-di hydroxybenzene ?

(a) a (b) d
(c) e (d) f

2. $Ph-\overset{\overset{O}{\|}}{C}-OH \xrightarrow{NaHCO_3} (A)\text{gas}$; $Ph-OH \xrightarrow{Na} (B)\text{gas}$

Sum of molecular mass of gas $(A+B=?)$

ANSWERS — LEVEL 2

1. A – d; B – b; C – a; D – b

2. 48

14 BIOMOLECULES

LEVEL-1

1. Which statement correctly completes the statement ?

Except for glycine, which is achiral, all the amino acids present in proteins .....

(a) are chiral, but racemic

(b) have the L configuration at their α carbon

(c) have the R configuration at their α carbon

(d) have the S configuration at their α carbon

2. Assume that a particular amino acid has an isoelectric point of 6.0. In a solution at pH 1.0, which of the following species will predominate ?

(a) $H_3\overset{+}{N}CH(R)CO_2H$

(b) $H_2NCH(R)CO_2H$

(c) $H_3\overset{+}{N}CH(R)CO_2^-$

(d) $H_2NCH(R)CO_2^-$

3. The pK_a values for the three ionizable groups X, Y and Z of glutamic acid are 4.3, 9.7 and 2.2 respectively

$$\underset{X}{HO_2C}-CH_2-\underset{+NH_3}{CH}-\underset{Z}{CO_2H}$$

The isoelectric point for the amino acid is :

(a) 7.00 (b) 3.25 (c) 4.95 (d) 5.95

4. An amino acid may be represented by general formula $H_2N-\underset{\displaystyle R}{\underset{|}{CH}}-COOH$. If $R = -CH_2C_6H_5$ then it is phenylalanine (Phe) and if $R = CH_3$ then it is alanine (Ala). Find the sequence of reagents from those given below to synthesize Phe- Ala.

(1) $ZNH\underset{\displaystyle CH_3}{\underset{|}{CH}}CO_2H$ (2) $H_2N\underset{\displaystyle CH_3}{\underset{|}{CH}}CO_2CH_2C_6H_5$

(3) $ZNH\underset{\displaystyle CH_2C_6H_5}{\underset{|}{CH}}CO_2H$ (4) $H_2N\underset{\displaystyle CH_2C_6H_5}{\underset{|}{CH}}CO_2CH_2C_6H_5$

(a) 1 and 2 (b) 1 and 4 (c) 2 and 3 (d) 3 and 4

5. Iso-electric point of alanine is (pH = 6). At which pH, maximum concentration of zwitter ion of alanine will be present ?

(a) pH > 6 (b) pH < 6 (c) pH = 6 (d) pH = 7

6. $NH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\overset{\displaystyle O}{\overset{\|}{C}}-NH-CH_2-CO_2H$

Identify the amino acid obtained by hydrolysis of the above compound:

(a) Glycine (b) Alanine (c) Both (a) and (b) (d) None of these

7. At iso-electric point :

(a) conc. of cation is equal to conc of anion

(b) Net charge is zero.

(c) Maximum conc. of di-polar ion (Zwitter ion) will be present

(d) All of the above

8. Which of following amino acid has lowest iso-electric point ?

(a) Glycine (b) Alanine (c) Aspartic acid (d) Lysine

9. Find iso-electric point of given amino acid

$CH_3-\underset{\displaystyle \overset{\oplus}{N}H_3}{\underset{|}{CH}}-CO_2H \quad pK_a = 2.2$

$pK_b = 4.4$

(a) 3.3 (b) 5.9 (c) 9.6 (d) 11.8

10. Find iso-electric point of the given amino acid

$H-O-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2-CH_2-\underset{\displaystyle \overset{\oplus}{N}H_3}{\underset{|}{CH}}-CO_2H \quad (pK_a = 2)$

$(pK_a = 4)$ $(pK_a = 9)$

(a) 5.5 (b) 6.5 (c) 3 (d) 5

11. $H-C\equiv C-H \xrightarrow[H_2SO_4]{HgSO_4} (A) \xrightarrow[(2)\ H_3O^{\oplus}]{(1)\ NH_3+HCN} (B)$; Product (*B*) of given reaction is :

(a) Glycine (b) Alanine
(c) valine (d) Leucine

12. Which amino acid does not contain chiral centre ?

(a) Valine (b) Leucine (c) Glycine (d) Iso-leucine

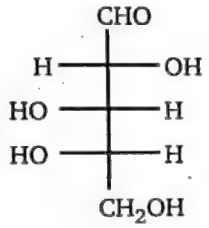
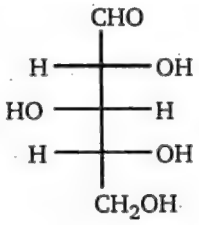
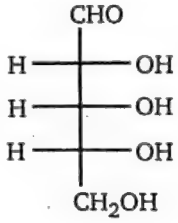
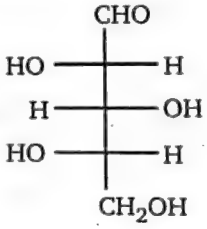
13. Which of the following is Sanger reagent ?

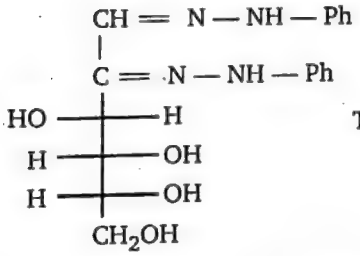
(a) 2,4-Di-nitro flurobenzene (b) Phenyl isocyanate
(c) 2, 4-Di-nitro chlorobenzene (d) 2, 4-Di-nitro iodobenzene

14. A D-carbohydrate is :

(a) Always dextrorotatory
(b) Always laevorotatory
(c) Always the mirror of the corresponding L-carbohydrate
(d) None of these

15. Which L-sugar on oxidation gives an optically active dibasic acid (2 COOH groups) ?

(a) 
(b) 
(c) 
(d) 

16. 

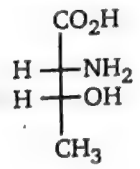
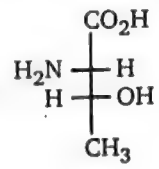
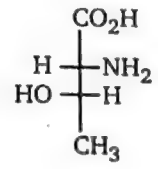
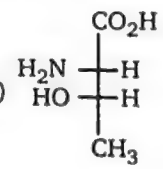
The given osazone can be obtained by :

(a) D-glucose (b) D-mannose (c) D-Idose (d) Both (a) & (b)

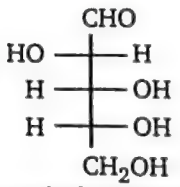
17. Which of the following pair gives same phenyl osazone ?

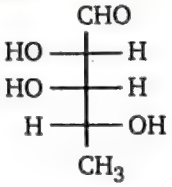
(a) D-Glucose and D-Allose (b) D-Glucose and D-Alfrose
(c) D-Glucose and D-Mannose (d) D-Glucose and D-Talose

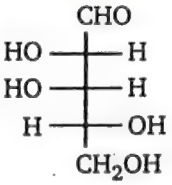
18. Which of the following is the Fischer projection of L-threonine (also known as (2S, 3R)-2-amino-3-hydroxybutanoic acid) ?

(a) 
(b) 
(c) 
(d) 

19. Among the three compounds shown below, two yield the same product on reaction with warm HNO_3. The exception is :

(a) 

(b) 

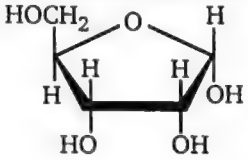
(c) 

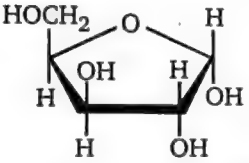
(d) None of these

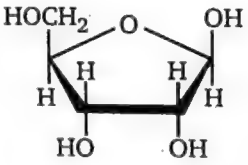
20. The optical rotation of the α- form of a pyranose is + 150.7°, that of the β- form is + 52.8°. In solution an equilibrium mixture of these anomers has an optical rotation of + 80.2°. The percentage of the α-form in equilibrium mixture is :

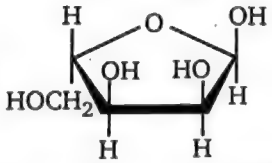
(a) 28% (b) 32 % (c) 68% (d) 72%

21. Which of the following represents the anomer of the compound shown ?



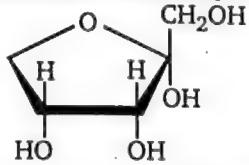
(a) 

(b) 

(c) 

(d) None of these

22. Which set of terms correctly identifies the carbohydrate shown ?



(1) Pentose (2) Pentulose (3) Hexulose (4) Hexose
(5) Aldose (6) Ketose (7) Pyranose (8) Furanose
(a) 2, 6, 8 (b) 2, 6, 7
(c) 1, 5, 8 (d) A set of terms other than these

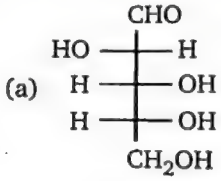
23. For the complex conversion of D-glucose into the corresponding osazone, the minimum number of equivalents of phenyl hydrazine required is :

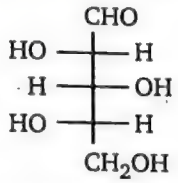
(a) two (b) three (c) four (d) five

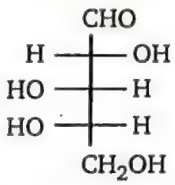
24. Which one of the following compounds will form an osazone derivative ?

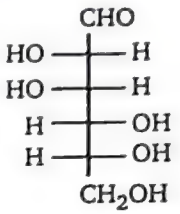
(a) $CH_3CH_2COCH_2OH$ (b) $CH_3COCH_2CH_2OH$
(c) $CH_3CH_2CHOHCH_2OH$ (d) $CH_3CH_2COCH_2OCH_3$

25. Which of the following structure is L-arabinose?

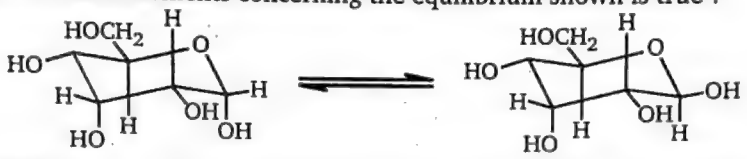
(a) 

(b) 

(c) 

(d) 

26. Which one of the statements concerning the equilibrium shown is true ?



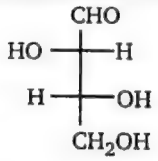
(a) The two structures are enantiomers of each other. They have equal but opposite optical rotations and recemize slowly at room temperature

(b) The two structures are enantiomers of each other. They racemize too rapidly at room temperature for their optical rotations to be measured

(c) The two structures are diastereomers of each other. Their interconversion is called mutarotation

(d) The two structures are diastereomers of each other. Their interconversion does not require breaking and making bonds, only a change in conformation

27. The configurations of the chirality centres in D-threose (shown) are :



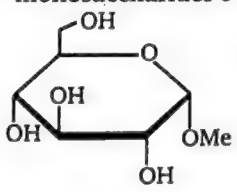
(a) 2R, 3R (b) 2R, 3S (c) 2S, 3R (d) 2S, 3S

28. Rapid interconversion of α-D-glucose and β-D-glucose in solution is known as :

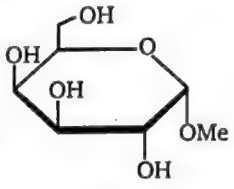
(a) racemization (b) asymmetric induction

(c) fluxional isomerization (d) mutarotation

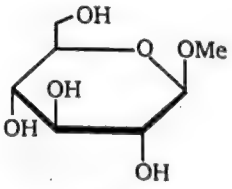
29. Identify the correct set of stereochemical relationships amongst the following monosaccharides I-IV.



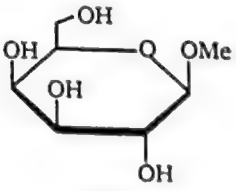
(I)



(II)



(III)



(IV)

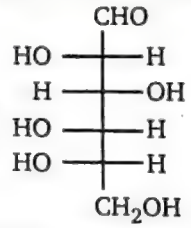
(a) I and II are anomers ; III and IV are epimers

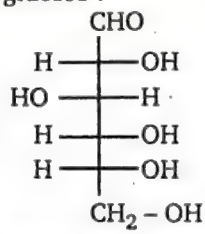
(b) I and III are epimers ; II and IV are anomers

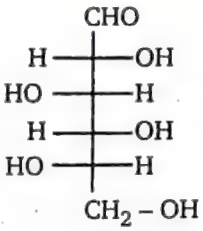
(c) I and II are epimers ; III and IV are anomers

(d) I and III are anomers ; I and II are epimers

30. What is the structure of L-glucose ?

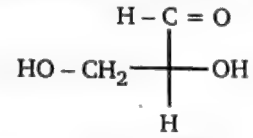
(a) 

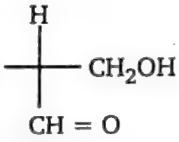
(b) 

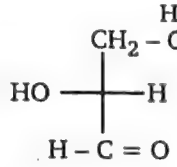
(c) 

(d) None of these

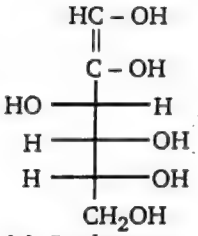
31. What is the structure of L-glyceraldehyde?

(a) 

(b) 

(c) 

(d) Both (a) and (b)

32.  , the given is enol form of :

(a) D-glucose (b) D-mannose (c) D-fructose (d) All of these

33. D-glucose $\overset{HO^-}{\rightleftharpoons}$ A + B; A and B are :

(a) D-mannose & D-mannitol (b) D-mannose & D-Fructose

(c) D-Allose & D-Altrose (d) D-Glucose & D-Idose

34. Stereoisomers of aldoheptose is (a) and stereoisomers of ketoheptose is (b). Ratio of a/b is :

(a) $\frac{1}{2}$ (b) $\frac{2}{1}$ (c) $\frac{4}{1}$ (d) $\frac{1}{4}$

35. D-Glucose $\xrightarrow[\Delta]{HNO_3}$ (A); Product (A) is :

(a) D-Gluconic acid (b) D-Glucitol (c) D-Fructose (d) D-Glucaric acid

36. D-glucose & D-fructose can be differentiated by :

(a) Fehling solution (b) Tollens reagent (c) Benedict test (d) Br_2/H_2O

37. D-Glucose exist in x different forms. The value of x (stereoisomer) is :

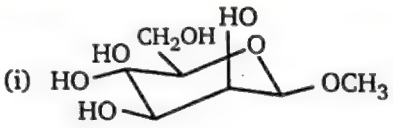
(a) 2 (b) 3 (c) 4 (d) 5

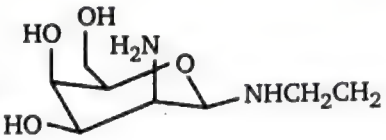
38. D-Mannose $\overset{HO^-}{\rightleftharpoons}$ D-Glucose $\overset{HO^-}{\rightleftharpoons}$ (A) ;

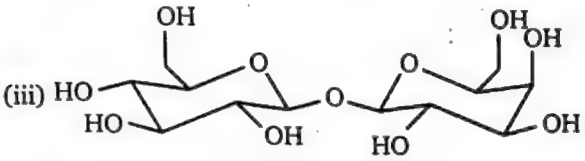
Product (A) of above reaction is

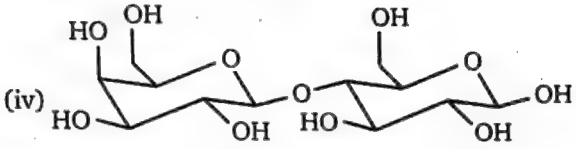
(a) D-glucose (b) D-fructose (c) D-talose (d) D-idose

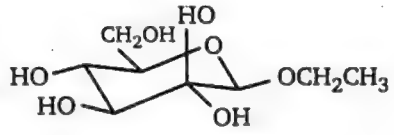
39. Which of the molecules below will react with Ag^+ ?

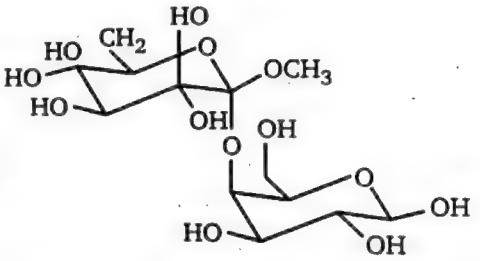
(i) 

(ii) 

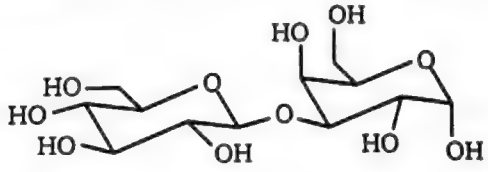
(iii) 

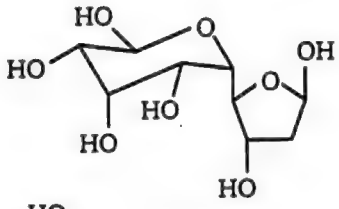
(iv) 

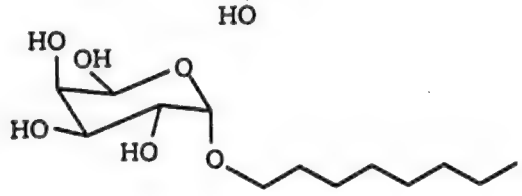
(v) 

(vi) 

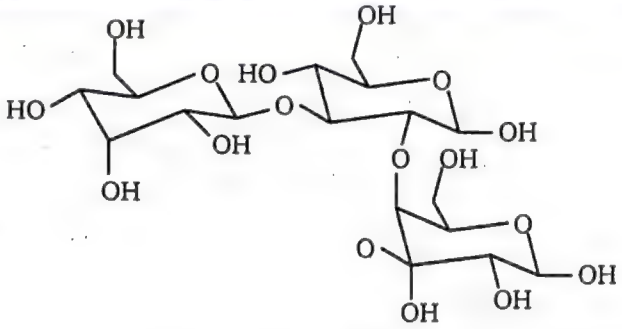
(a) (i), (iii) and (v) (b) (ii) and (iv) (c) (iv) and (vi) (d) (i), (ii), (iii) and (vi)

40. **A.** 

B. 

C. 

D.

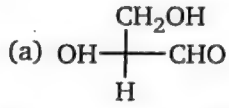
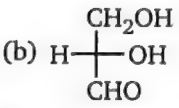
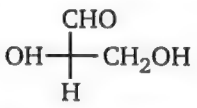
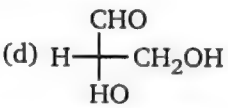


Which of the compounds (A-D) depicted above is NOT a hemiacetal linkage ?

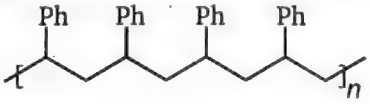
(a) Compound A (b) Compound B (c) Compound C (d) Compound D

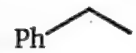
(e) None of the above (they are all hemiacetals)

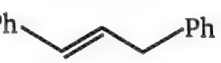
41. Which of the following Fischer projection formula is same as D-Glyceraldehyde ?

(a)  (b)  (c)  (d) 

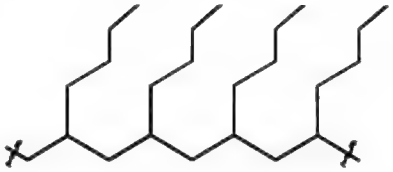
42. What is the structure of the monomer from which the following polymer was made ?

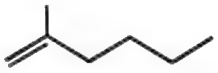


(a)  (b) 

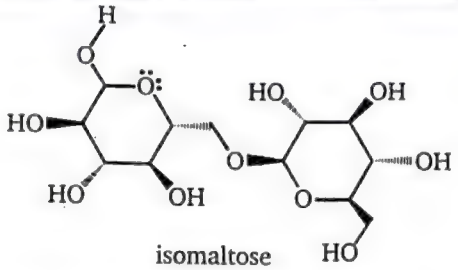
(c)  (d) 

43. The following structure represents a subunit of a hydrocarbon polymer that may be prepared by a radical polymerization method. Identify the monomer that has been polymerized to make this polymer chain.



(a)  (b)  (c)  (d) 

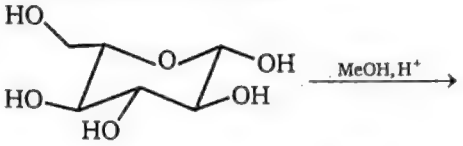
44. Choose the answer that has correctly identified the number of acetals and hemiacetals in isomaltose.



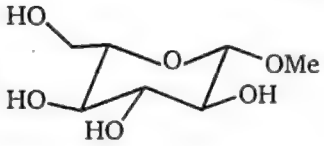
isomaltose

	Acetal	Hemiacetal		Acetal	Hemiacetal
(a)	0	0	(b)	1	0
(c)	0	1	(d)	1	1

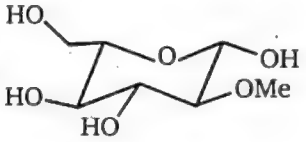
45. Predict the product of the following reaction.



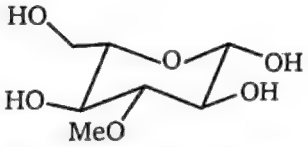
(a)



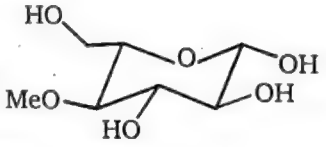
(b)



(c)



(d)



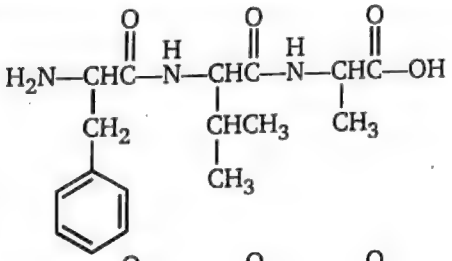
46 Which reagent/s can be used to distinguish glucose and fructose ?

(I) Bromine water (II) Tollen's reagent (III) Schiff's reagent

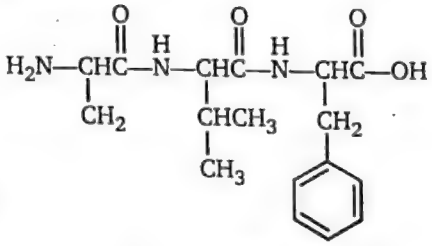
(a) (I), (II) and (III) (b) (II) and (III) (c) Only (I) (d) Only (III)

47. Choose the peptide that matches the abbreviation Phe-Val-Ala.

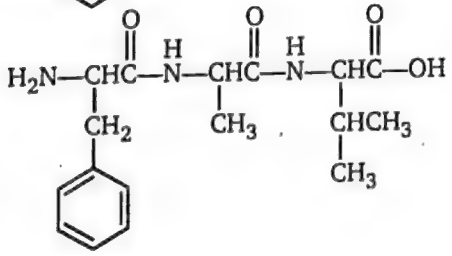
(a)



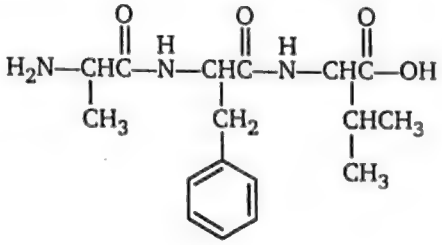
(b)



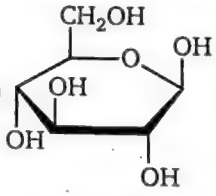
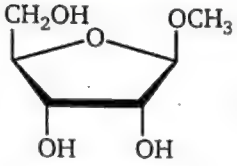
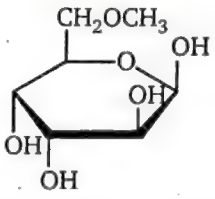
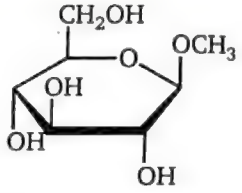
(c)



(d)

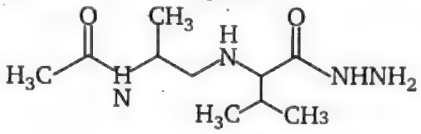


48. Which of the following carbohydrate(s) would not undergo mutarotation in aqueous solution?

(I) 
(II) 
(III) 
(IV) 

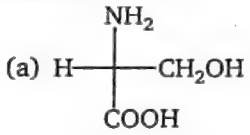
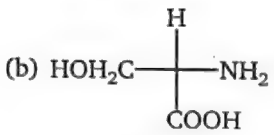
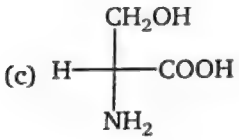
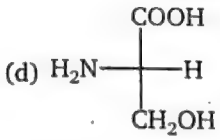
(a) II only (b) I, III and IV only (c) II and IV only (d) I and III only

49. The number of peptide bonds in the compound.



(a) 1 (b) 2 (c) 3 (d) 4

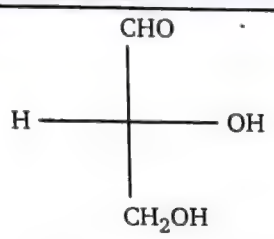
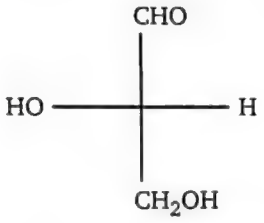
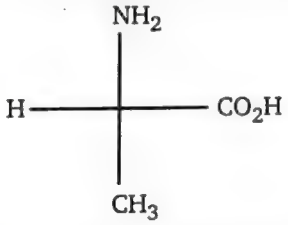
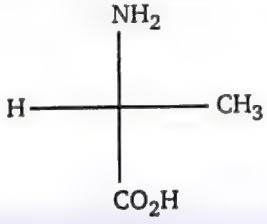
50. Serine ($HOCH_2CH(NH_2)COOH$) is an essential amino acid. The correct Fisher projection of serine is

(a) 
(b) 
(c) 
(d) 

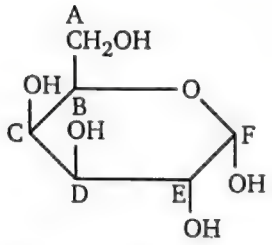
ANSWERS — LEVEL 1															
1.	(b)	**2.**	(a)	**3.**	(b)	**4.**	(b)	**5.**	(c)	**6.**	(c)	**7.**	(d)	**8.**	(c)
9.	(b)	**10.**	(c)	**11.**	(b)	**12.**	(c)	**13.**	(a)	**14.**	(d)	**15.**	(a)	**16.**	(d)
17.	(c)	**18.**	(b)	**19.**	(b)	**20.**	(a)	**21.**	(b)	**22.**	(a)	**23.**	(b)	**24.**	(a)
25.	(c)	**26.**	(c)	**27.**	(c)	**28.**	(d)	**29.**	(d)	**30.**	(a)	**31.**	(d)	**32.**	(d)
33.	(b)	**34.**	(b)	**35.**	(d)	**36.**	(d)	**37.**	(b)	**38.**	(b)	**39.**	(c)	**40.**	(e)
41.	(c)	**42.**	(b)	**43.**	(c)	**44.**	(d)	**45.**	(a)	**46.**	(c)	**47.**	(a)	**48.**	(c)
49.	(a)	**50.**	(d)												

LEVEL-2

1. Match the Column (I) and Column (II). (Matrix)

Column (I)		Column (II)	
Molecule		**Configuration**	
(a)		**(p)**	R- (Rectus)
(b)		**(q)**	S- (Sinister)
(c)		**(r)**	D
(d)		**(s)**	L

2. Comprehension



One cyclic acetal form of D-galactose is shown above.

A. Which atom is the anomeric carbon ?

(a) Atom A (b) Atom B (c) Atom C (d) Atom D

(e) Atom E (f) Atom F

B. Which name most completely describes this cyclic acetal form ?

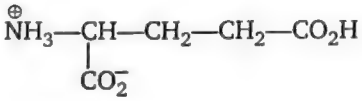
(a) α-D-Galactofuranose (b) β -P- Galactofuranose

(c) α-D- Galactopyranose (d) β -D- Galactopyranose

3. How many compound which is given below is isomer of *D*-Glucose ?

D-Mannose, *D*-Fructose, *D*-Gulose, *D*-Idose, *D*-Galactose, *D*-Arabinose, *D*-Ribose.

4. How many acidic group is present in given amino acid ?



ANSWERS — LEVEL 2

1. a – p, r; b – q, s; c – q, s; d – p, r

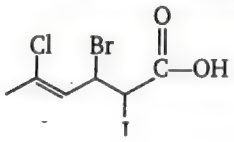
2. A – f; B – c

3. 5

4. 2

15 IUPAC NAME

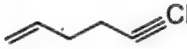
LEVEL- 1

1. 

Total number of substituent present in the above compound :

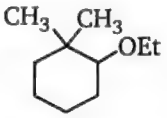
(a) 1 (b) 2

(c) 3 (d) 4

2.  IUPAC name will be :

(a) Hex-5-en-1-yne (b) Hex-1-en-5-yne

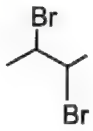
(c) Hex-6-en-1-yne (d) Hex-1-en-6-yne

3. IUPAC name of  is

(a) 1-Ethoxy-2, 2-dimethylcyclohexane (b) 2-ethoxy-1, 1-dimethyl cyclohexane

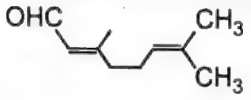
(c) 1, 1-Dimethyl-2-ethoxycyclohexane (d) 2-methyl-1, 1-ethoxy cyclohexane

4. How many secondary carbon and hydrogen atoms are present in the molecule given below respectively ?



(a) 2, 3 (b) 2, 2 (c) 3, 3 (d) 2, 0

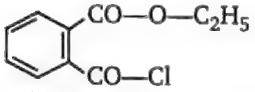
5. Which IUPAC name is correct for the given compound ?



(a) 3, 7-dimethylocta-2, 6-dienal (b) 2, 6-dimethyloct-2, 6-dienal-8

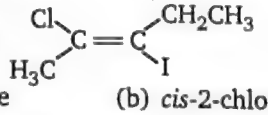
(c) 7-formyl-2, 6-dimethylhept-2, 6-diene (d) 7-aldo-2,6-dimethylhept-2, 6-diene

6. Write the IUPAC name of the following compound :



(a) ethyl-2-(chlorocarbonyl) benzoate (b) ethyl-2-(chlorocarbonyl) hexanoate

(c) 2-(thoxycarbonyl) benzoyl chloride (d) None of these

7. The IUPAC name of the compound  is :

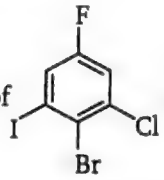
(a) *trans*-2-chloro-3-iodo-2-pentene (b) *cis*-2-chloro-3-iodo-2-pentene

(c) *trans*-3-iodo-4-chloro-3-pentene (d) *cis*-3-iodo-4-chloro-3-pentene

8. The IUPAC name of the compound is :

(a) 2-methyl-6-oxohex-3-enamide (b) 6-keto-2-methyl hexanamide

(c) 2-carbamoylhexanal (d) 2-carbamoylhex-3-enal

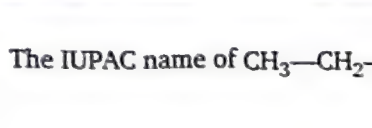
9. The IUPAC name of  is:

(a) 1-Bromo-2-chloro-3-fluoro-6-iodo benzene

(b) 2-Bromo-1-chloro-5-fluoro-3-iodo benzene

(c) 4-Bromo-2-chloro-5-iodo-1-fluoro benzene

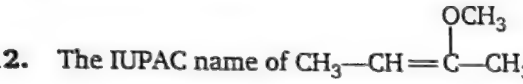
(d) 2-Bromo-3-chloro-1-iodo-5-fluoro benzene

10. The IUPAC name of  is:

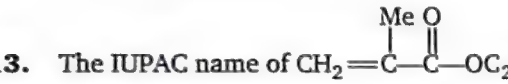
(a) Methyl 2-ethylbutanoate
(b) 1-methoxy-2-ethylbutanone
(c) 3-Methoxycarbonylpentane
(d) 1-methoxy-2-ethylbutanal

11. The IUPAC name of  is:

(a) But-1-en-4-oic acid
(b) 1-hydroxybut-2-en-1-one
(c) But-2-en-1-oic acid
(d) But-2-en-4-oic acid

12. The IUPAC name of  is:

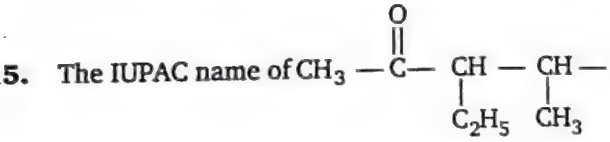
(a) 1-Methoxy-1-methylpropene
(b) 2-Methoxybut-2-ene
(c) dimethylpropeneether
(d) none of these

13. The IUPAC name of  is:

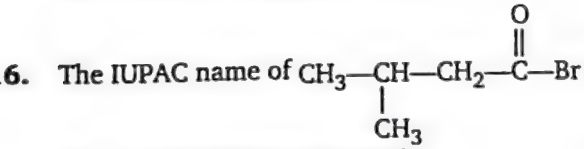
(a) Ethyl 2-methylprop-2-enoate
(b) Ethyl 2-methylprop-1-enoate
(c) 1-Ethoxy-2-methylprop-2-enone
(d) 1-Ethoxy-2-methylprop-2-enal

14. The IUPAC name of  is:

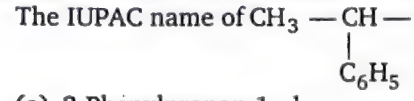
(a) 2, 3-Dimethylbutan-4-amine
(b) 2, 4-Dimethylbutan-1-amine
(c) 2,4-Dimethylbutan-4-amine
(d) 2, 3-Dimethylbutan-1-amine

15. The IUPAC name of  is:

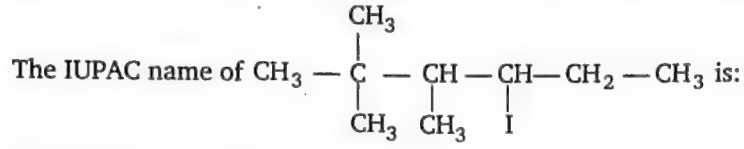
(a) 3-(Methylethyl) pentan-2-one
(b) 3-(Methylethyl)pentan-4-one
(c) 3-Ethyl-4-methylpentan-2-one
(d) 3-Ethyl-2-methylpentan-4-one

16. The IUPAC name of  is:

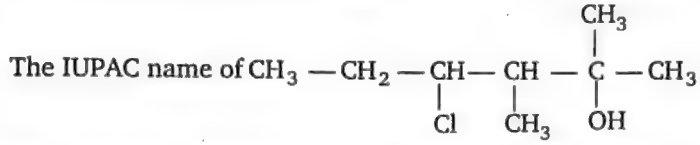
(a) 2-Methylbutanoyl bromide
(b) 2-Methylbutan-4-oyl bromide
(c) 1-Bromo-3-Methylbutanone
(d) 3-Methylbutanoyl bromide

17. The IUPAC name of  is:

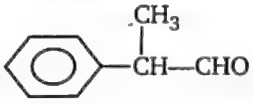
(a) 2-Phenylpropan-1-ol
(b) 2-Phenylpropan-3-ol
(c) 1-(2-Hydroxy-1-methylethyl) benzene
(d) 1-((Hydroxymethyl)ethyl) benzene

18. The IUPAC name of  is:

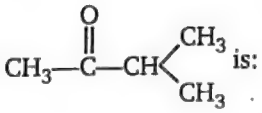
(a) 3-Iodo-4,5,5-trimethylhexane
(b) 4-Iodo-1, 1, 3-trimethylhexane
(c) 4-Iodo-2, 2-dimethylheptane
(d) 4-Iodo-2, 2, 3-trimethylhexane

19. The IUPAC name of  is:

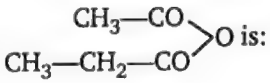
(a) 4-Chloro-2, 3-dimethylhexane-2-ol
(b) 4-Chloro-2-hydroxy-2, 3-dimethylhexane
(c) 4-Chloro-1, 1, 2-trimethylpentan-2-ol
(d) 3-Chloro-2, 3-dimethylhexane-2-ol

20. The IUPAC name of  is:

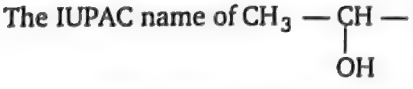
(a) 2-Phenylpropan-3-al
(b) Formylethylbenzene
(c) 2-Phenylpropanal
(d) Ethylformylbenzene

21. The IUPAC name of  is:

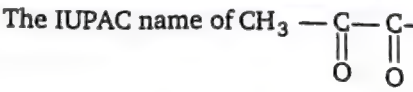
(a) 2-Methylbutan-3-one
(b) 3-Methylbutan-2-al
(c) 2-Methylbutan-3-al
(d) 3-Methylbutan-2-one

22. The IUPAC name of  is:

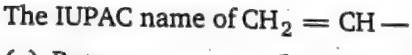
(a) Ethanoic propanoic anhydride
(b) Propanoic ethanoic anhydride
(c) 1-Ethanoyloxypropanone
(d) 3-Ethanoyloxypropan-3-one

23. The IUPAC name of  is:

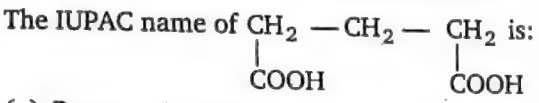
(a) 3-Ethylbutane-2, 4-diol
(b) 2-Ethylbutane-1, 3-diol
(c) 3-Ethylbutane-1, 3-diol
(d) 2-Ethyl-1-methylpropane-1, 3-diol

24. The IUPAC name of  is:

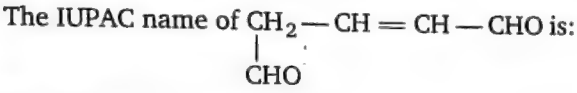
(a) Butane-2, 3-dial
(b) Butane-1, 3-dione
(c) Butane-2, 3-dione
(d) 1, 2-dimethylethanedione

25. The IUPAC name of  is:

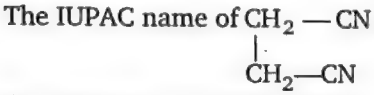
(a) Butane (b) Buta-1, 3-diene (c) Butane-1, 3-diene (d) none of these

26. The IUPAC name of  is:

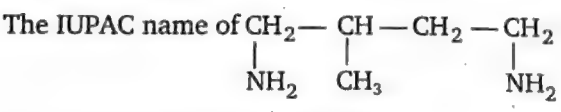
(a) Pentane-1, 5-dioic acid
(b) Pentane-1, 5-dicarboxylic acid
(c) Propane-1, 3-dioic acid
(d) none of these

27. The IUPAC name of  is:

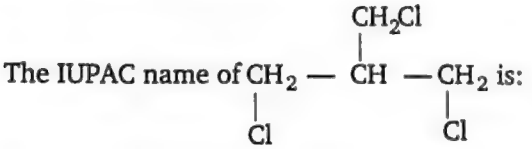
(a) propene-1, 3-dial
(b) Propene-1, 3-dicarbaldehyde
(c) Pent-3-ene-1, 5-dial
(d) Pent-2-ene-1, 5-dial

28. The IUPAC name of  is:

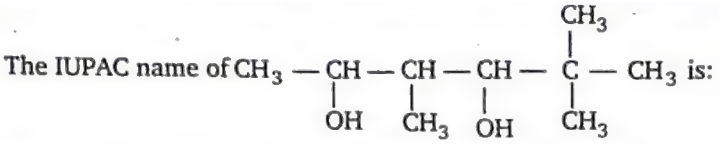
(a) Butane-1, 4-dicarbonitrile
(b) Ethane-1, 2-dicarbonitrile
(c) Ethane-1, 2-dinitrile
(d) Butane-1, 4-dinitrile

29. The IUPAC name of  is:

(a) 2-Methylbutane-1, 4-diamine
(b) 3-Methylbutane-1, 4-diamine
(c) 3-(Aminomethyl)butanamine
(d) 2-(Aminomethyl)butan-4-amine

30. The IUPAC name of 

(a) Tris(chloromethyl) methane
(b) 1, 3-Dichloro-2 (chloromethyl) propane
(c) 1-Chlorobis(chloromethyl) ethane
(d) none of these

31. The IUPAC name of  is:

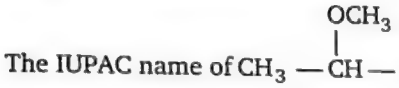
(a) 3, 5, 5-Trimethylhexane-2, 4-diol (b) 2, 2, 4-Trimethylhexane-3, 5-diol

(c) 1, 2, 4, 4-Tetramethylpantane-1, 3-diol (d) 2, 2, 4, 5-Tetramethylpantane-3, 5-diol

32. The IUPAC name of $HOOC-CH=CH-COOH$ is:

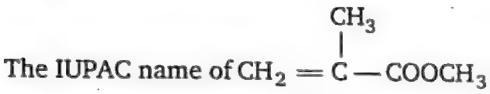
(a) But-2-ene-1, 4-dicarboxylic acid (b) But-2-ene-1, 4-dioic acid

(c) Ethene dicarboxylic acid (d) Ethene dioic acid

33. The IUPAC name of  is:

(a) 1-Formyl-1-methoxyethane (b) 2-Methoxypropan-3-one

(c) 2-Methoxypropanal (d) 2-Methoxypropan-3-al

34. The IUPAC name of  is:

(a) Methyl-2-methylprop-1-en-3-oate (b) 2-Methoxycarbonylpropene

(c) 2-Methoxycarbonylprop-2-ene (d) Methyl-2-methylprop-2-enoate

35. The IUPAC name of $CH_3-CH=CH-COOH$ is:

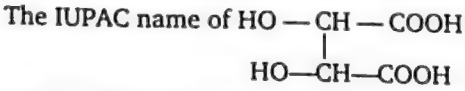
(a) But-2-ene-1-oic acid (b) But-1-ene-1-oic acid

(c) But-2-ene-1-carboxylic acid (d) Propene-1-carboxylic acid

36. The IUPAC name of  is:

(a) 2-Hydroxypropanoic acid (b) 1-Hydroxypropanoic acid

(c) 1-Hydroxyethane carboxylic acid (d) 1-Hydroxyethanoic acid

37. The IUPAC name of  is:

(a) 2, 3-Dihydroxybutane-1, 4-carboxylic acid

(b) 2, 3-Dihydroxybutane-1, 4-dioic acid

(c) 1, 2-Dihydroxyethane dicarboxylic acid

(d) none of these

38. The IUPAC name of  is:

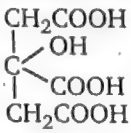
(a) 3-Methyl-2-oxobutanecarboxylic acid (b) 2-Methyl-3-oxobutan-4-oic acid

(c) 3-Methyl-2-oxobutanoic acid (d) 3-Methyl-1,2-dioxobutanoic acid

39. The IUPAC name of $NC-CH_2-CH_2-COOH$ is:

(a) 3-Carboxy propanenitrile (b) 4-Cyanobutanoic acid

(c) 2-Cyanoethane Carboxylic acid (d) 3-Cyanopropanoic acid

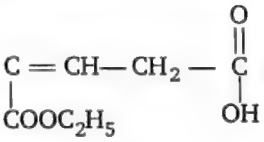
40. The IUPAC name of  is:

(a) 3-Carboxy-3-hydroxypentanedicarboxylic acid

(b) 2-Hydroxypropane-1, 2, 3-tricarboxylic acid

(c) 2-Hydroxypropane-1, 2, 3-trioic acid

(d) 3-Hydroxypropane-1, 2, 3-tricarboxylic acid

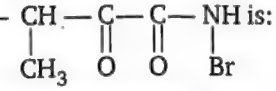
41. The IUPAC name of  is:

(a) 4-ethoxycarbonylpent-3-enoic acid

(b) 4-ethanoyloxypent-3-enoic acid

(c) 3-ethoxycarbonylbut-2-enecarboxylic acid

(d) 3-ethoxycarbonylpent-3-enoic acid

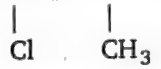
42. The IUPAC name of  is:

(a) (*N*-Bromo)-2-keto-3-methylbutanamide

(b) (*N*-Bromo)-2-keto-4-methylbutanamide

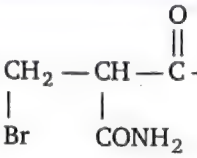
(c) (*N*-Bromo)-1, 2-diketo-3-methylbutanamine carboxamide

(d) (*N*-Bromo)-1-keto-2-methylpropane

43. The IUPAC name of  is:

(a) 4-Chloro-3-methylbut-2-en-1-ol (b) 1-Chloro-2-methylbut-2-en-4-ol

(c) 4-Chloro-1-hydroxy-3-methylbut-2-ene (d) 1-Chloro-4-hydroxy-2-methylbut-2-ene

44. The IUPAC name of  is:

(a) 2-(Bromomethyl)-3-oxopentane carboxamide

(b) 1-Bromo-2-carbamoylpentan-3-one

(c) 5-Bromo-4-carbamoylpentan-3-one

(d) 2-(Bromomethyl)-3-oxopentanamide

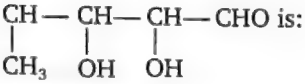
45. The IUPAC name of $(CH_3)_3C \cdot CH_2CH_2Cl$ is:

(a) 2, 2-Dimethyl-4-chloro butane

(b) 1-Chloro-3, 3-dimethylbutane

(c) 4-Chloro-2, 2-dimethyl butane

(d) none of these

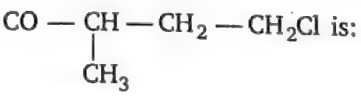
46. The IUPAC name of  is:

(a) 2, 3-Dihydroxy-4-methylpentanal

(b) 1-oxo-2, 3-Dihydroxy-4-methylpentane

(c) 2,3-Dihydroxy-4-methylpentanone

(d) 1, 2-Dihydroxy-3-methylbutanecarbaldehyde

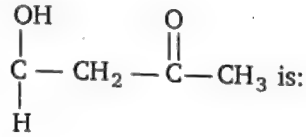
47. The IUPAC name of  is:

(a) 1-Chloro-3-methylpentan-4-one

(b) 1-Chloro-2-(oxoethylbutane)

(c) 5-Chloro-3-methylpentan-2-one

(d) 3-(2-Chloroethyl)butan-2-one

48. The IUPAC name of  is:

(a) 2-Hydroxypentan-4-one

(b) 4-Hydroxypentan-2-one

(c) 4-oxopentan-2-ol

(d) 2-oxopentan-4-ol

49. The IUPAC name of $CH_3-\underset{Cl}{CH}-\underset{Br}{CH}-\underset{OH}{CH}-CH_3$ is:

(a) 3-Bromo-4-chloropentan-2-ol

(b) 3-Bromo-2-chloro-4-hydroxypentane

(c) 3-Bromo-2-chloropentane-4-ol

(d) none of these

50. The IUPAC name of $CH_3-CH_2-\underset{OH}{\overset{Br}{\overset{|}{C}}}-\overset{Cl}{\overset{|}{CH}}-CH_2-Cl$ is:

(a) 3-Bromo-4, 5-dichloropentan-3-ol

(b) 3-Bromo-1, 2-dichloro-3-hydroxypentane

(c) 3-Bromo-1, 2-dichloropentan-3-ol

(d) 3-Bromo-4, 5-dichloro-3-hydroxypentane

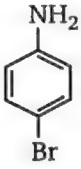
51. The IUPAC name of $CH_3-\underset{OH}{CH}-CH_2-O-C_2H_5$ is:

(a) 1-Ethoxypropan-2-ol

(b) 3-Ethoxypropan-2-ol

(c) 1-Ethoxy-2-hydroxypropane

(d) none of these

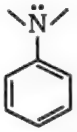
52. The IUPAC name of  is:

(a) 4-Bromo benzenamine

(b) 4-Amino-1-bromobenzene

(c) 4-Bromo benzenamide

(d) 1-Bromo benzencarboxamide

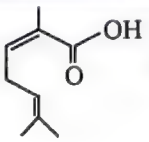
53. The IUPAC name of  is:

(a) *N*, *N*-Dimethyl aminobenzene

(b) *N*, *N*-Dimethyl benzenamine

(c) (a) and (b) both are correct

(d) none of these

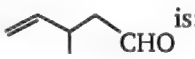
54. The IUPAC name of  is:

(a) 2, 6-Dimethylhepta-2, 5-dienoic acid

(b) 3, 7-Dimethylhepta-2, 5-dienoic acid

(c) 1-Hydroxy-2, 6-dimethylhepta-2, 5-dienone

(d) none of these

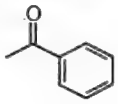
55. The IUPAC name of  is:

(a) 3-Methylpent-1-en-4-al

(b) 3-Methylpent-4-enal

(c) 3-Methylpent-4-carbaldehyde

(d) 3-Methyl-5-oxopent-1-ene

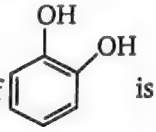
56. The IUPAC name of  is:

(a) 2-Phenyl ethanone

(b) 1-Phenyl ethanone

(c) 1-(Oxoethyl)benzene

(d) 1-(Ethyaloxo)-benzene

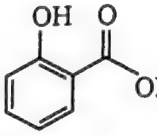
57. The IUPAC name of  is:

(a) 2-Hydroxybenzenol

(b) 1, 2-Dihydroxybenzene

(c) Benzene-1, 2-diol

(d) 2-Hydroxyphenol

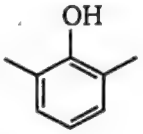
58. The IUPAC name of  is:

(a) 2-Carboxyphenol

(b) 2-Hydroxybenzoic acid

(c) 1-Carboxy-2-hydroxybenzene

(d) 2-Carboxy-1-hydroxybenzene

59. The IUPAC name of  is:

(a) 1,3-Dimethyl phenol

(b) 1-Hydroxy-2-6-dimethyl benzene

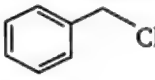
(c) 2, 6-Dimethyl benzenol

(d) 2-Hydroxy-1-3-dimethylbenzene

60. $Ph—CH=CH—\overset{\overset{O}{\|}}{C}—OH$

The IUPAC name is :

(a) 3-phenyl prop-2-enoic acid
(b) 3-phenol prop-1-enoic acid
(c) 3-carboxy-prop-1-ene benzene
(d) but-2-enoic acid

61. The IUPAC name of  is:

(a) Chloromethylbenzene
(b) Chlorophenylmethane
(c) (a) and (b) both
(d) none of these

62. The IUPAC name of the compound having the formula is :

$$H_3C-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH=CH_2$$

(a) 3, 3, 3-Trimethylprop-1-ene
(b) 1, 1, 1-Trimethylprop-2-ene
(c) 3, 3-Dimethylbut-1-ene
(d) 2, 2-Dimethylbut-3-ene

63. The IUPAC name of the compound $CH_2=CH-CH(CH_3)_2$ is :

(a) 1, 1-Dimethylprop-2-ene
(b) 3-Methylbut-1-ene
(c) 2-Vinyl propane
(d) none of these

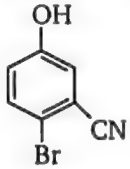
64. The number of sigma and pi-bonds in 1-butene 3-yne are :

(a) 5 sigma and 5 pi
(b) 7 sigma and 3 pi
(c) 8 sigma and 2 pi
(d) 6 sigma and 4 pi

65. The IUPAC name of C_6H_5COCl is :

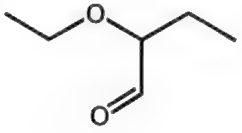
(a) Benzoyl Chloride
(b) Benzene chloro ketone
(c) Benzene carbonyl chloride
(d) Chloro phenyl ketone

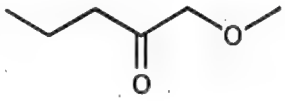
66. The IUPAC name of the following compound is :

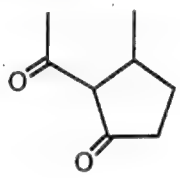


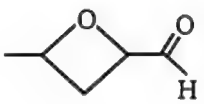
(a) 4-Bromo-3-cyanophenol
(b) 2-Bromo-5-hydroxybenzonitrile
(c) 2-Cyano-4-hydroxybromobenzene
(d) 6-Bromo-3-hydroxybenzonitrile

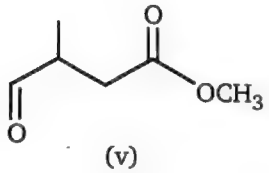
67. Many organic compounds contain more than one functional group. Which of the following is both an aldehyde and an ether ?


(i)


(ii)

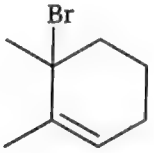

(iii)

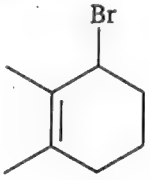

(iv)


(v)

(a) (i) only
(b) (i) and (iv)
(c) (ii) and (v)
(d) (iii) and (iv)

68. What is the sum of positions assigned to bromine while numbering the Parent Chain in the below compounds ?


(I)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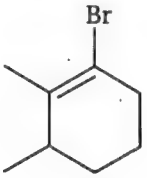
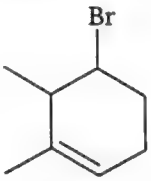
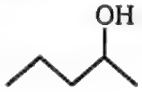
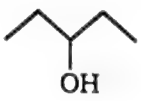

(III)

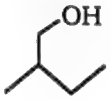

(IV)

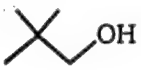
(a) 13
(b) 14
(c) 15
(d) 16

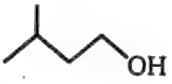
69. How many number of compounds, which have same IUPAC name ?

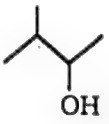


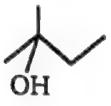






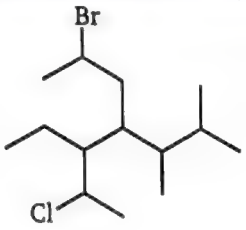




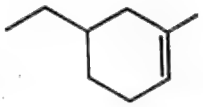


(a) 0
(b) 1
(c) 2
(d) 3

70. How many total number of substituents are present in the following compound ?



(a) 3 (b) 4 (c) 5 (d) 6

71. 

Correct IUPAC name :

(a) 1-methyl-3-ethylcyclohexene (b) 5-ethyl-1-methylcyclohexene

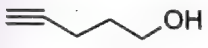
(c) 2-ethyl-4-methylcyclohexene (d) 3-ethyl-1-methylcyclohexene

ANSWERS — LEVEL 1

1.	(c)	**2.**	(b)	**3.**	(b)	**4.**	(b)	**5.**	(a)	**6.**	(a)	**7.**	(a)	**8.**	(a)
9.	(b)	**10.**	(a)	**11.**	(c)	**12.**	(b)	**13.**	(a)	**14.**	(d)	**15.**	(c)	**16.**	(d)
17.	(a)	**18.**	(d)	**19.**	(a)	**20.**	(c)	**21.**	(d)	**22.**	(a)	**23.**	(b)	**24.**	(c)
25.	(b)	**26.**	(a)	**27.**	(d)	**28.**	(d)	**29.**	(a)	**30.**	(b)	**31.**	(a)	**32.**	(b)
33.	(c)	**34.**	(d)	**35.**	(a)	**36.**	(a)	**37.**	(b)	**38.**	(c)	**39.**	(d)	**40.**	(b)
41.	(a)	**42.**	(a)	**43.**	(a)	**44.**	(d)	**45.**	(b)	**46.**	(a)	**47.**	(c)	**48.**	(b)
49.	(a)	**50.**	(c)	**51.**	(a)	**52.**	(a)	**53.**	(b)	**54.**	(a)	**55.**	(b)	**56.**	(b)
57.	(c)	**58.**	(b)	**59.**	(c)	**60.**	(a)	**61.**	(b)	**62.**	(c)	**63.**	(b)	**64.**	(b)
65.	(c)	**66.**	(b)	**67.**	(b)	**68.**	(c)	**69.**	(a)	**70.**	(c)	**71.**	(b)		

LEVEL-2

Give the IUPAC name of the following compounds

1. 

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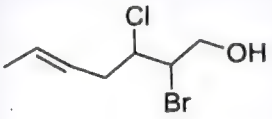
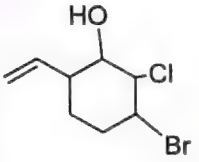
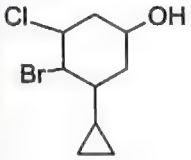
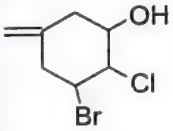
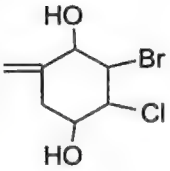
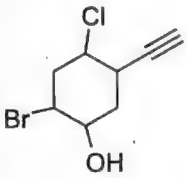
3. 

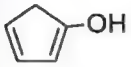
4. 

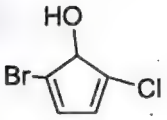
5. 

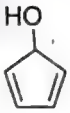
6. 

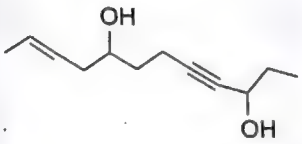
7. 

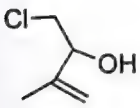
8. 

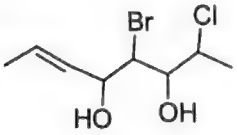
9. 

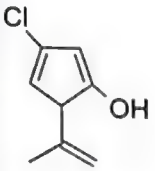
10. 

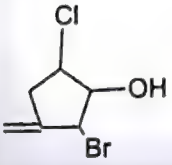
11. 

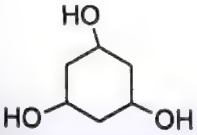
12. 

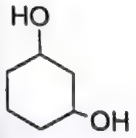
13 

14. 

15. 

16 

17 

18. 

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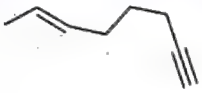
20. 

21. 

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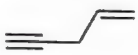
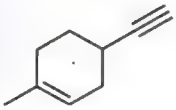
25. 

26. 

27. 

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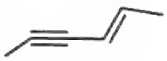
29. 

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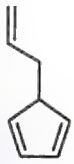
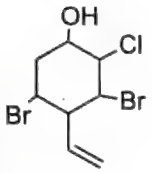
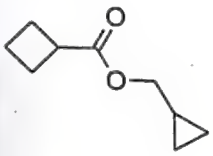
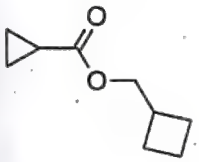
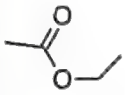
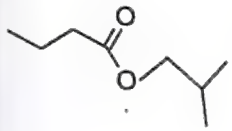
31. 

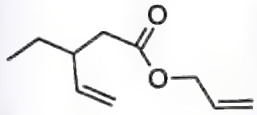
32. 

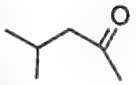
33. 

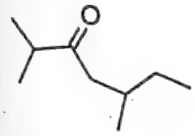
34. 

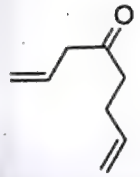
35. 

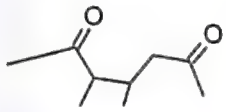
36. 

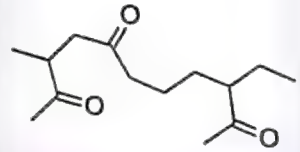
37. 

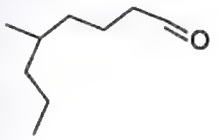
38. 

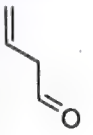
39. 

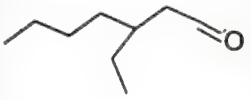
40. 

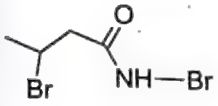
41. 

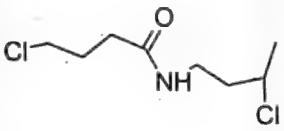
42. 

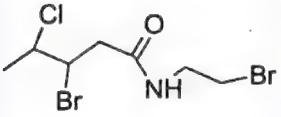
43. 

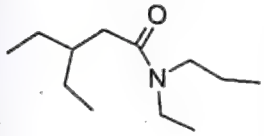
44. 

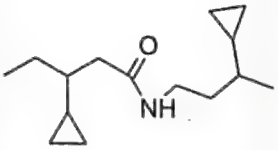
45. 

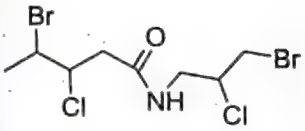
46. 

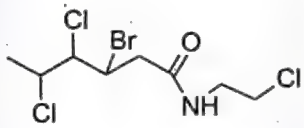
47. 

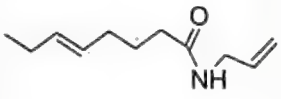
48. 

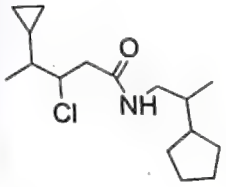
49. 

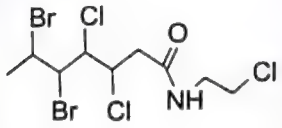
50. 

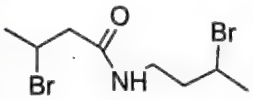
51. 

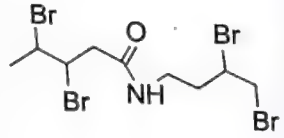
52. 

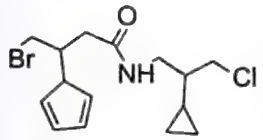
53. 

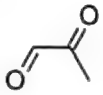
54. 

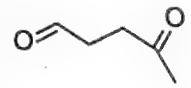
55. 

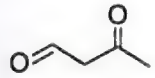
56. 

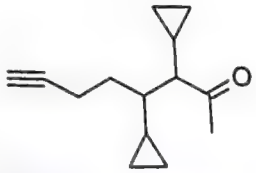
57. 

58. 

59. 

60. 

61. 

62. 

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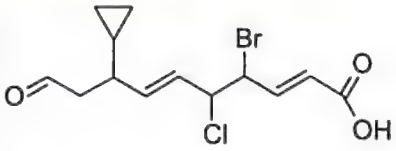

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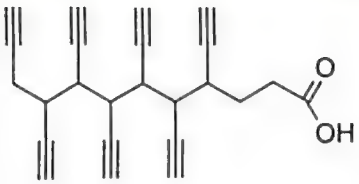

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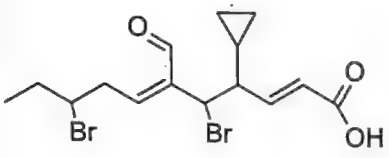

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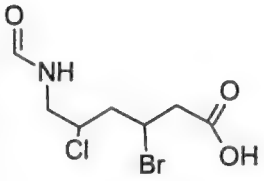

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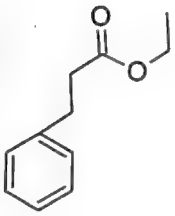

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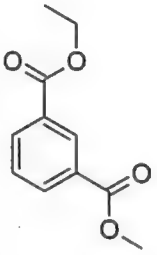

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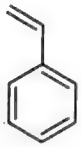

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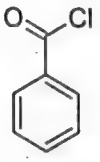

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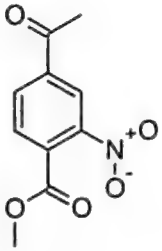

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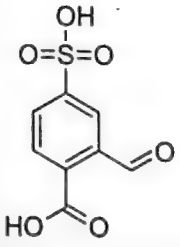
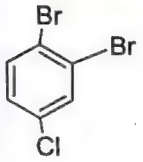
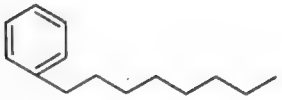
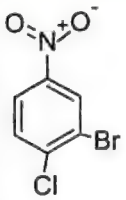
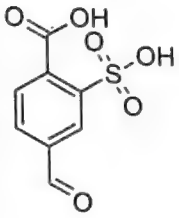
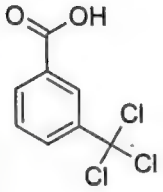


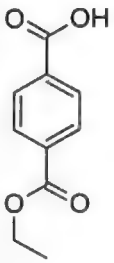
73. 

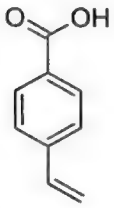
74. 

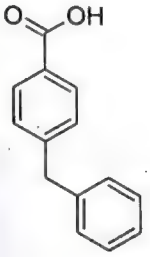
75. 

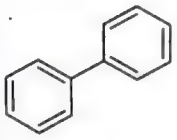
76. 

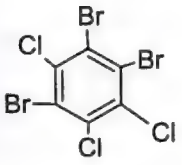
77. 

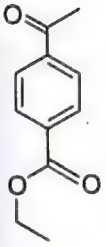
78. 

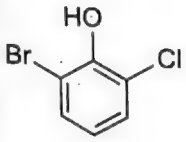
79. 

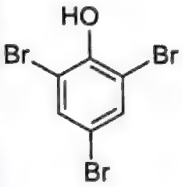
80. 

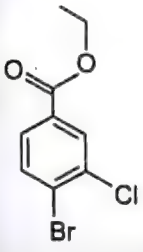
81. 

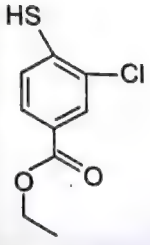
82. 

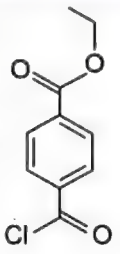
83. 

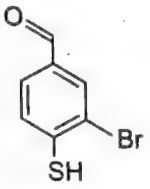
84. 

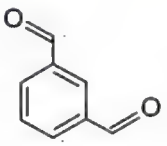
85. 

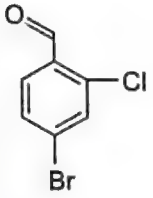
86. 

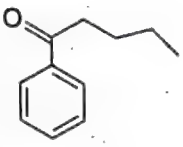
87. 

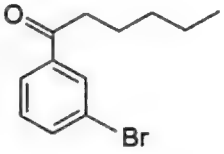
88 

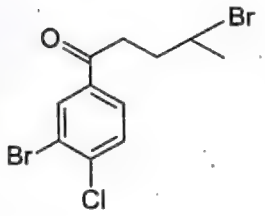
89. 

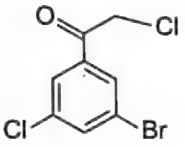
90. 

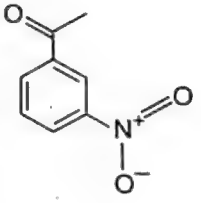
91. 

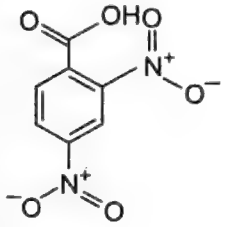
92. 

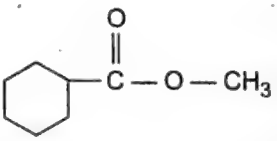
93. 

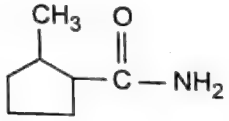
94. 

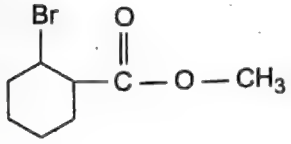
95. 

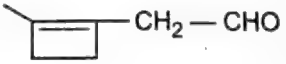
96. 

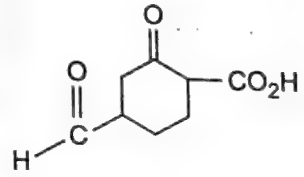
97. 

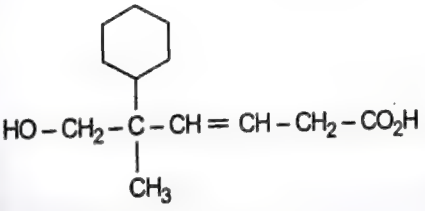
98. 

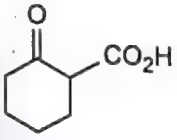
99. 

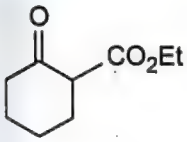
100 

101. 

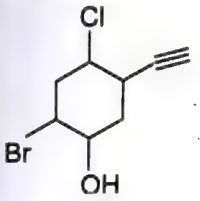
102. 

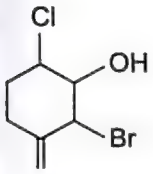
103. 

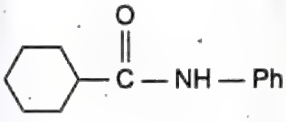
104. 

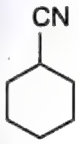
105. 

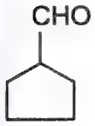
106. $CH_3-NH-CHO$

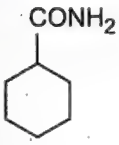
107. 

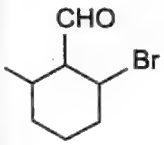
108. 

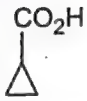
109. 

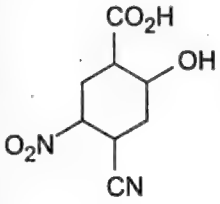
110. 

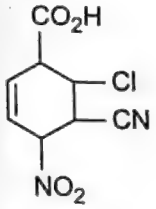
111. 

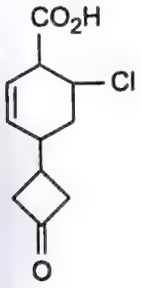
112. 

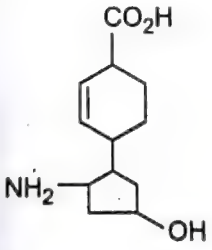
113. 

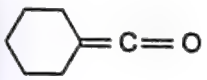
114. 

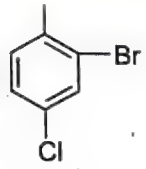
115. 

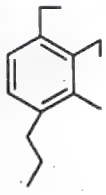
116. 

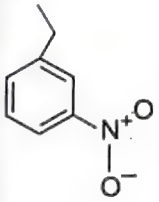
117. 

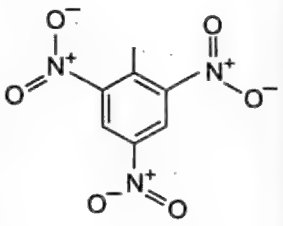
118. 

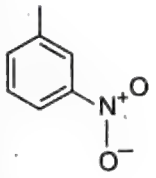
119. 

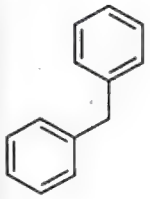
120. 

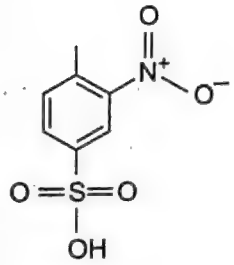
121. 

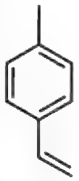
122. 

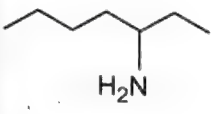
123. 

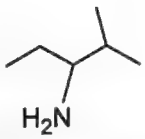
124. 

125. 

126. 

127. 

128. 

129. 

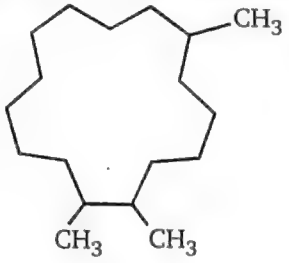
130. Give the IUPAC name of the following compounds :

(a) $CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

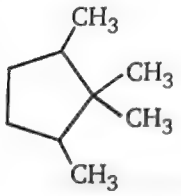
(b) $CH_3-CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$

(c) $CH_3-CH_2-CH_2-\underset{\displaystyle CH_3-CH_2-CH}{\underset{|}{CH_2}}-\underset{\displaystyle CH-CH_3}{\underset{|}{CH_2}}-CH_3$

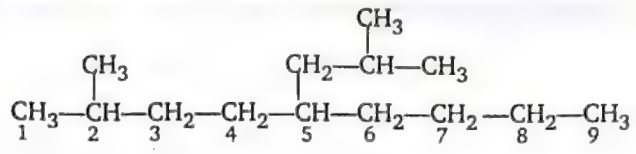
(d)

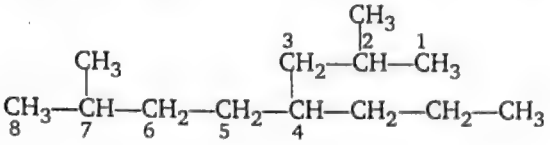


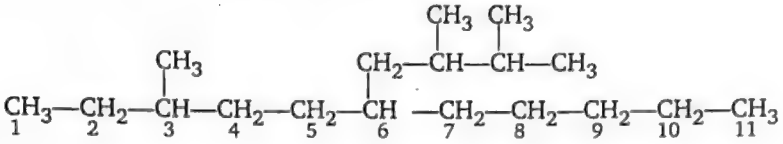
(e)

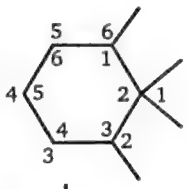


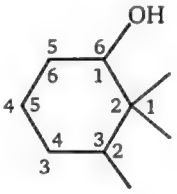
131. Give the IUPAC name of the following :

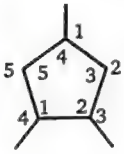
(a) 

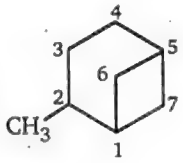
(b) 

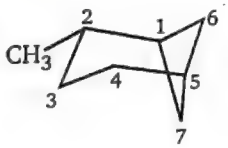
(c) 

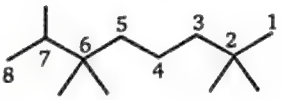
(d) 

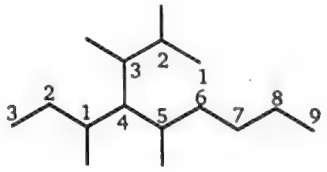
(e) 

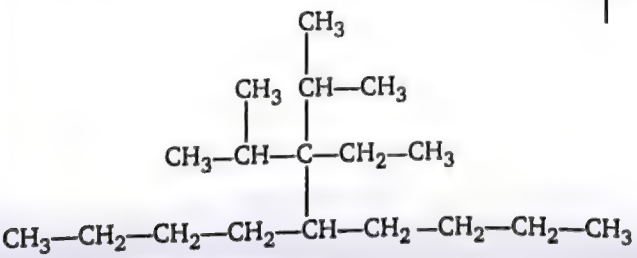
(f) 

(g) 

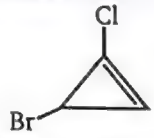
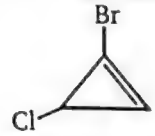
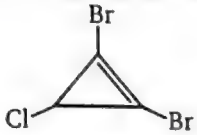
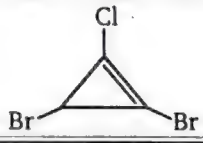
(h) 

(i) 

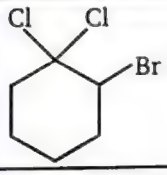
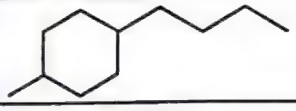
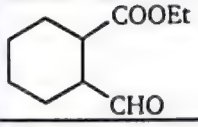
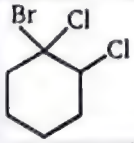
(j) 

(k) 

132. Match the Column :

Column (I)		Column (II)	
Compound		IUPAC Name	
(a)		(p)	1, 3-dibromo-2-chlorocyclopropane
(b)		(q)	1, 2-dibromo-3-chlorocyclopropene
(c)		(r)	3-bromo-1-chlorocyclopropene
(d)		(s)	1-bromo-3-chlorocyclopropene

133. Match the Column :

Column (I)		Column (II)	
(a)		(p)	1-butyl-4-methyl cyclohexane
(b)		(q)	2-bromo-1,1-dichloro cyclohexane
(c)		(r)	1-Bromo-1,2-dichloro cyclohexane
(d)		(s)	Ethyl-2-formyl cyclohexane carboxylate

SUBJECTIVE PROBLEMS

1. 

When IUPAC name of following compound is given, then double bond and substituent gets respectively
(x and y) number so the sum of $(x + y)$ will be

ANSWERS – IUPAC Name			
1.	pent-4-yn-1-ol	**2.**	pent-4-en-1-ol
3.	(5*E*)-2-bromo-3-chlorohept-5-en-1-ol	**4.**	3-bromo-2-chloro-6-ethenylcyclohexanol
5.	4-bromo-3-chloro-5-cyclopropylcyclohexanol		
6.	3-bromo-2-chloro-5-methylidenecyclohexanol		
7.	3-bromo-2-chloro-5-methylidenecyclohexane-1,4-diol		
8.	2-bromo-4-chloro-5-ethynylcyclohexanol	**9.**	cyclopenta-1,3-dien-1-ol
10.	2-bromo-5-chlorocyclopenta-2,4-dien-1-ol		
11.	cyclopenta-2,4-dien-1-ol	**12.**	dodec-10-en-4-yne-3,8-diol
13.	1-chloro-3-methylbut-3-en-2-ol	**14.**	4-bromo-2-chlorooct-6-ene-3,5-diol
15.	3-chloro-5-(1-methylethenyl)cyclopenta-1,3-dien-1-ol		
16.	2-bromo-5-chloro-3-methylidenecyclopentanol		
17.	cyclohexane-1,3,5-triol	**18.**	cyclohexane-1,3-diol
19.	cyclopenta-1,3-diene	**20.**	(6*E*)-oct-6-en-1-yne
21.	but-1-en-3-yne	**22.**	(3*Z*)-pent-3-en-1-yne
23.	buta-1,3-diyne	**24.**	(2*E*)-dec-2-en-5-yne
25.	(6*Z*)-dodec-6-en-2-yne	**26.**	pent-1-en-4-yne
27.	4-ethynyl-1-methylcyclohexene	**28.**	cyclooctyne
29.	(2*E*)-hex-2-en-4-yne	**30.**	5-ethynylcyclopenta-1,3-diene
31.	5-(prop-2-enyl) cyclopenta-1,3-diene		
32.	3,5-dibromo-2-chloro-4-ethenylcyclohexanol		
33.	cyclopropylmethyl cyclobutanecarboxylate		
34.	cyclobutylmethyl cyclopropanecarboxylate		
35.	ethyl ethanoate	**36.**	2-methylpropyl butanoate
37.	prop-2-enyl 3-ethylpent-4-enoate	**38.**	4-methylpentan-2-one
39.	2,5-dimethylheptan-3-one	**40.**	octa-1,7-dien-4-one
41.	3,4-dimethylheptane-2,6-dione	**42.**	9-ethyl-3-methylundecane-2,5,10-trione

43.	5-methyloctanal	**44.**	but-3-enal
45.	3-ethylheptanal	**46.**	*N*,3-dibromobutanamide
47.	4-chloro-*N*-(3-chlorobutyl)butanamide		
48.	3-bromo-*N*-(2-bromoethyl)-4-chloropentanamide		
49.	*N*,3-diethyl-*N*-propylpentanamide		
50.	3-cyclopropyl-*N*-(3-cyclopropylbutyl)pentanamide		
51.	4-bromo-*N*-(3-bromo-2-chloropropyl)-3-chloropentanamide		
52.	3-bromo-4,5-dichloro-*N*-(2-chloroethyl)hexanamide		
53.	(5*E*)-*N*-(prop-2-en-yl)oct-5-enamide		
54.	3-chloro-*N*-(2-cyclopentylpropyl)-4-cyclopropylpentanamide		
55.	5,6-dibromo-3,4-dichloro-*N*-(2-chloroethyl)heptanamide		
56.	3-bromo-*N*-(3-bromobutyl)butanamide		
57.	3,4-dibromo-*N*-(3,4-dibromobutyl)pentanamide		
58.	4-bromo-*N*-(3-chloro-2-cyclopropylpropyl)-3-(cyclopenta-2,4-dien-yl)butanamide		
59.	2-oxopropanal	**60.**	4-oxopentanal
61.	3-oxobutanal	**62.**	3,4-dicyclopropyloct-7-yn-2-one
63.	(2*E*,6*E*)-4-bromo-5-chloro-8-cyclopropyl-10-oxodeca-2,6-dienoic acid		
64.	4,5,6,7,8,9-hexaethynyldodec-11-ynoic acid		
65.	(2*E*,6*E*)-5,9-dibromo-4-cyclopropyl-6-formylundeca-2,6-dienoic acid		
66.	3-bromo-5-chloro-6-(formylamino)hexanoic acid		
67.	ethyl 3-phenylpropanoate	**68.**	ethyl methyl benzene-1,3-dicarboxylate
69.	ethenylbenzene	**70.**	benzoyl chloride
71.	methyl 4-acetyl-2-nitrobenzoate	**72.**	2-formyl-4-sulphobenzoic acid
73.	1,2-dibromo-4-chlorobenzene	**74.**	octylbenzene
75.	2-bromo-1-chloro-4-nitrobenzene	**76.**	4-formyl-2-sulphobenzoic acid
77.	3-(trichloromethyl)benzoic acid	**78.**	4-(ethoxycarbonyl)benzoic acid

79.	4-ethenylbenzoic acid	**80.**	4-benzylbenzoic acid
81.	biphenyl	**82.**	1,2,5-tribromo-3,4,6-trichlorobenzene
83.	ethyl 4-acetylbenzoate	**84.**	2-bromo-6-chlorophenol
85.	2, 4, 6-tribromophenol	**86.**	ethyl 4-bromo-3-chlorobenzoate
87.	ethyl 3-chloro-4-mercapto/sulpho benzoate	**88.**	ethyl 4-(chlorocarbonyl)benzoate
89.	3-bromo-4-sulphobenzaldehyde	**90.**	benzene-1, 3-dicarbaldehyde
91.	4-bromo-2-chlorobenzaldehyde	**92.**	1-phenylpentan-1-one
93.	1-(3-bromophenyl)hexan-1-one		
94.	4-bromo-1-(3-bromo-4-chlorophenyl)pentan-1-one		
95.	1-(3-bromo-5-chlorophenyl)-2-chloroethanone		
96.	1-(3-nitrophenyl)ethanone	**97.**	2,4-dinitrobenzoic acid
98.	methylcyclohexane carboxylate	**99.**	2-methylcyclopentane carboxamide
100.	methyl-2-bromocyclohexane carboxylate	**101.**	2-(2-methylcyclobut-1-enyl)ethanal
102.	4-formyl-2-oxocyclohexane-1-carboxylic acid		
103.	5-cyclohexyl-6-hydroxy-5-methylhex-3-en-1-oic acid		
104.	2-oxocyclohexane-1-carboxylic acid	**105.**	ethyl-2-oxocyclohexane-1-carboxylate
106.	*N*-methylmethanamide	**107.**	2-bromo-4-chloro-5-ethynylcyclohexanol
108.	2-bromo-6-chloro-3-methylidene-cyclohexanol		
109.	*N*-phenylcyclohexane carboxamide	**110.**	cyclohexane carbonitrile
111.	cyclopentanecarbaldehyde	**112.**	cyclohexanecarboxamide
113.	2-bromo-6-methyl-cyclohexanecarbaldehyde		
114.	cyclopropane carboxylic acid		
115.	4-cyno-2-hydroxy-5-nitrocyclohexane carboxylic acid		
116.	6-chloro-5-cyno-4-nitrocyclohex-2-ene carboxylic acid		
117.	6-chloro-4-(3-oxo cyclobutyl)cyclohex-2-ene carboxylic acid		
118.	4-(2-amino-4-hydroxycyclopentyl cyclohex-2-enecarboxylic acid		

119.	cyclohexylidenemethanone	**120.**	2-bromo-4-chloro-1-methylbenzene
121.	1,2-diethyl-3-methyl-4-propylbenzene	**122.**	1-ethyl-3-nitrobenzene
123.	2-methyl-1, 3, 5-trinitrobenzene	**124.**	1-methyl-3-nitrobenzene
125.	Diphenylmethane	**126.**	4-Methyl-3-nitrobenzene sulphonic acid
127.	1-ethenyl-4-methylbenzene	**128.**	heptan-3-amine
129.	2-methylpentan-3-amine		
130.	**(a)** 2,11-dimethyltridecane		
	(b) 12-methyl-tridecan-3-ol		
	(c) 4-ethyl-3-methyloctane		
	(d) 1,2,7-trimethylcyclopentadecane		
	(e) 1,1,2,5-tetramethylcyclopentane		
131.	**(a)** 5-isobutyl-2-methylnonane, 5-2-methylnonane (2-methylpropyl)		
	(b) 2,7-dimethyl-4-propyloctane		
	(c) 6-(2,3-dimethylbutyl) 3-methyl undecane		
	(d) 1,1,2,6-tetramethylcyclohexane		
	(e) 2,2,3-trimethylcyclohexanol		
	(f) 1,2,4-trimethylcyclopentane		
	(g) 2-methylbicyclo[3.1.1] heptane		
	(h) 2-methylbicyclo[3.1.1] heptane		
	(i) 2,2,6,6,7-pentamethyloctane		
	(j) 4-(1methylpropyl)-2,3,5-trimethyl nonane **Not** 2-butyl		
	(k) 5-(1-ethyl-2-methyl-1-(1-methylethyl)propyl) nonane		
132.	a - r; b - s; c - q; d - p		
133.	a - q; b - p; c - s; d - r		

Subjective Problems

1. 4